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**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

Order Instituting Rulemaking on the
Commission's own motion to consider renewal
of the Electric Program Investment Charge
Program.

R.19-10-005
(Filed October 10, 2019)

**OPENING BRIEF OF
PACIFIC GAS AND ELECTRIC COMPANY (U 39-E) ON
PHASE 2 ISSUES**

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I. INTRODUCTION.

Pursuant to California Public Utilities Commission Decision (D.) 20-08-042, Pacific Gas and Electric Company ("PG&E") provides its Opening Brief on Phase 2 issues in this proceeding.¹

As discussed in more detail below, PG&E recommends as follows regarding the issues to be considered in Phase 2 of this proceeding:

1. For the reasons stated in PG&E's comments on the proposed decision which was approved as revised in D.20-08-042, the Commission should continue IOU funding and administration of EPIC technology demonstration projects for a ten year period at the same level of funding as previously approved by the Commission for IOU EPIC funding and administration in previous EPIC triennial plan decisions.
2. The Commission staff should provide a detailed list of recommended improvements it is seeking in IOU administration of EPIC technology demonstration funding that have not previously been evaluated, recommended and approved by the Commission in prior EPIC decisions, including the IOUs' joint Research Administration Plan (RAP) as approved by the Commission in D.20-02-003. The Commission should schedule a public workshop for collaborative discussion of the recommended improvements, and stakeholders should have an opportunity to comment on the recommendations.

¹ D.20-08-042, pp. 2, 45- 28.

3. Following the workshop and written comments on the Commission staff's recommendations, the Commission should issue a final decision by no later than March, 2021, approving, disapproving or modifying the Commission staff's recommendations and authorizing the IOUs to continue funding and administering EPIC technology demonstration projects at the same level of funding as previous EPIC decisions, subject to the reporting and performance metrics and administrative improvements applicable to all the EPIC administrators, including the California Energy Commission.

4. In determining the IOUs' role in the renewed EPIC program, if the Commission determines that the IOUs should no longer autonomously administer their EPIC technology demonstration projects, PG&E alternatively will seek appropriate technology demonstration program funding in its Phase 1 General Rate Cases, where requests for such funding can be evaluated effectively and efficiently consistent with the safety, resiliency, clean energy and grid modernization needs evaluated in those GRCs.

II. RESPONSES TO PHASE 2 QUESTIONS AND ISSUES.

1. *In light of the current economic recession, is a 20 percent reduction in the current EPIC surcharge appropriate? Would a ten percent reduction in the total budget be more appropriate? Are any other budgetary changes necessary?*

PG&E Response: No. Given the importance of Technology Demonstration and Deployment (TD&D) projects, particularly to support PG&E's and the Commission's high-priority safety, resiliency, wildfire risk mitigation and clean energy goals, PG&E recommends against any reduction in the current EPIC funding for technology demonstration projects, let alone a reduction that would directly and significantly reduce the IOUs' current 20% share of the overall EPIC program budget as stated in the Phase 1 decision.² A 10% overall EPIC budget reduction taken completely from the IOUs' share would reduce the IOUs' budgets by 50%, and a 20% overall budget reduction unless modified would eliminate the IOUs' budgets entirely.

²D.20-08-042, p. 21-22.

As stated in PG&E's Opening Comments to the Phase 1 Proposed Decision, the elimination of PG&E's \$18 million share in annual EPIC funding would save the average residential customer only about 70 cents a year; average CARE customers would save only about 40 cents per year.³ The critical safety and resiliency objectives on which PG&E's technology demonstration projects are now focused more than justify the nominal customer costs of funding these efforts. Additionally, if any funding reduction is necessary during the current COVID-19 economic crisis, it may be more prudent to reduce the EPIC budget in investment areas that are more purely research or market subsidies, such as Applied Research and Development or Market Facilitation, rather than applying the reductions completely to technology demonstration projects that will produce new capabilities in the near-term to directly support the IOUs' and California's critical safety and resiliency priorities. However, PG&E does not recommend any reduction in the EPIC program budget, given the significant benefits of all RD&D for California's clean energy, safety and resiliency priorities.

2. *Other than the direct administrative role that PG&E, SCE, and SDG&E had in prior EPIC investment cycles, is there another manner in which the utilities can participate in EPIC research projects? For example, should a certain portion of the CEC's budget be allocated for the utilities, and/or should utility investment proposals be represented in CEC investment plans? How could the Commission ensure that the expertise and applied knowledge of the IOUs informs EPIC research without continuing the IOUs' direct administrative role as previously structured? If the existing structure, with the electric utilities continuing with direct administrative roles is deemed the preferred option, despite its documented flaws, how does the Commission ensure that the utilities comply with their obligations as administrators?*

PG&E Response: No. The IOUs should retain their role as direct program administrators.

As stated by the Commission in its previous EPIC decisions and by PG&E and the other IOUs in Phase 1 of this proceeding, the expertise and applied knowledge of the IOUs cannot be effectively applied to address PG&E's highest priority challenges, CPUC directives and

³ PG&E Opening Comments on Phase 1 PD, R.19-10-005, p. 4.

state policy goals without continuing the IOUs' direct role as administrators and preserving their autonomy to shape and execute their EPIC investments.⁴

Furthermore, the record in this proceeding also demonstrates that there are no specific "documented flaws" in IOU EPIC administration and reporting that the IOUs and the Commission have not already addressed and committed to eliminate, such as through the IOUs' joint Research Administration Plan (RAP) and the Commission's D.20-02-003 adopting improvements in IOU EPIC administration and reporting. If there are additional "documented flaws," PG&E recommends that Commission staff develop a detailed listing of such flaws so that the IOUs, EPIC stakeholders, the CEC, and the Commission can collaboratively address and cure such flaws. The Commission should schedule a public workshop for collaborative discussion of the recommended improvements, and stakeholders should have an opportunity to comment on the recommendations. Following the workshop and written comments on the Commission staff's recommendations, the Commission should issue a final decision by no later than March, 2021, approving, disapproving or modifying the Commission staff's recommendations and authorizing the IOUs to continue funding and administering EPIC technology demonstration projects.

Without a common understanding among EPIC stakeholders of any specific flaws, or further priority administrative issues requiring improvement that have not already been addressed, there is no factual basis for assessing or eliminating the IOUs' administrative role. To the extent that there are specific improvements that the Commission would like to see implemented, beyond those already approved from the IOUs' RAP, it is more appropriate to align or consolidate specific administrative functions among all four Administrators, rather than have the CEC subsume the IOUs' programs entirely and eliminate the IOUs' direct administrative role. PG&E looks forward to collaborating with the Commission and stakeholders to identify targeted improvements to address any specific flaws. Most of the

⁴ See, generally, PG&E's opening and reply comments on the Phase 1 Proposed Decision; also see, D.20-08-042, p. 29; Findings of Fact 1 and 2, p. 31.

myriad of administrative functions necessary for efficient administration of IOU EPIC programs, such as investment planning, detailed business plan development, benchmarking, and the positioning of grid technologies for post-EPIC adoption are functions the IOUs themselves are best-suited to perform, particularly for technology demonstration projects and programs. A summary of the specific functions that comprise IOU EPIC administration is provided in Appendix A. Transitioning these responsibilities wholesale to a non-IOU administrator, rather than remediating them and continuing IOU administration, would likely result in significant unintended inefficiencies and reductions in program value.

Lastly, irrespective of any specific changes made to the EPIC program's administrative structure or the relationship between the IOU and CEC EPIC programs and RD&D areas, key foundational attributes need to be in place for successful IOU RD&D programs:

- Direct IOU administrative responsibility to:
 - Define priority areas (capabilities) for RD&D focus
 - Define specific projects
 - Execute projects
- Predictable, stable and sustained funding
- Timely access to funds
- Sufficient funding to make progress on the myriad safety, reliability, resiliency and GHG challenges facing California
- Flexibility to respond to emergent needs within an investment cycle

If these foundational attributes are not reflected in the IOU programs that are set in this phase of the proceeding, the IOU programs will be significantly hampered and unable to deliver the emerging technology development and demonstration capabilities required to address the challenges facing California's customers and electric industry. In such circumstances, PG&E alternatively would seek appropriate technology demonstration funding in its Phase 1 General Rate Cases, where requests for such funding also can be evaluated effectively and efficiently consistent with the safety, resiliency, clean energy and grid modernization needs evaluated in such GRCs. This would be consistent with Ordering

Paragraph 17 in D.12-05-037 which restricted the IOUs from including electric RD&D expenditures in their General Rate Cases to the extent their RD&D expenditures are directly funded and available through the EPIC program.

3. *How should the Commission determine more specific guiding principles and policy priorities for EPIC?*
 - a. *Do the “complementary guiding principles” established in D.12-05-037 need refinement and/or updating?*
 - b. *How should the Commission establish additional policy priorities for the program? Should the Commission provide direction for areas, goals, and/or strategies that the Commission wants to ensure are highlighted or prioritized by EPIC, within the context of the mandatory guiding principles and other program rules?*
 - c. *What should be the process/cadence for revisiting these principles and priorities?*

PG&E Response: The Commission should leverage and update the current EPIC program’s Commission-approved guiding principles and collaborate with all four EPIC administrators and RD&D stakeholders to develop and employ a framework for identifying, updating and maintaining EPIC policy priorities in light of California’s updated energy and environmental priorities, including risk and safety assessments, new clean energy goals, and safety and resiliency priorities in light of climate change and wildfire risks and mitigation plans.

- a. *Do the “complementary guiding principles” established in Decision (D.) 12-05-037 need refinement and/or updating?*

Ordering Paragraph 2 of D.12-05-037 states: “The primary and mandatory guiding principle of the Electric Program Investment Charge shall be to provide electricity ratepayer benefits, defined as promoting greater reliability, lower costs, and increased safety, with the following complementary guiding principles:

- a. Societal benefits;
- b. Greenhouse gas emissions mitigation and adaptation in the electricity sector at the lowest possible cost;
- c. The loading order;
- d. Low-emission vehicles/transportation;

- e. Economic development; and
- f. Efficient use of ratepayer monies.”⁵

PG&E recommends that grid resiliency be added as a distinct primary principle, given the direct importance to customers of a resilient grid, and the critical role that RD&D has played in the current EPIC program and will continue to play in furthering this objective. PG&E also recommends that equity be added as a complementary guiding principle, given the importance of understanding and addressing the needs of Low-Income customers and Disadvantaged Communities (DACs).

- b. *How should the Commission establish additional policy priorities for the program? Should the Commission provide direction for areas, goals, and/or strategies that the Commission wants to ensure are highlighted or prioritized by EPIC, within the context of the mandatory guiding principles and other program rules?*

This issue relates to the discussion in D.18-10-052 of Evergreen Evaluation’s finding that there is a need for the Commission to help prioritize among EPIC's many objectives.⁶ In examining whether the Administrators’ investment planning frameworks are effective in creating a portfolio that has the “optimal” mix of projects, the Evaluation found that while Administrators’ investment planning processes result in a collection of projects that together meet all the various EPIC program requirements, it was not possible to determine if the Administrators’ investment planning frameworks are effective in creating a portfolio that has the “optimal” mix of projects because the Commission has not established priorities among many principles, policies and strategic objectives for investment in RD&D. The Commission supported this recommendation to provide guidance on priorities, but also noted that they “do not intend to remake EPIC into a fully directed program, since as the Evaluation notes we must balance the narrowing of focus that results from prioritization with the value of broad R&D investments.”⁷

⁵ D.12-05-037, Ordering Paragraph 2, p. 99.

⁶ D.18-10-052 pp. 25-29.

⁷ *Id.*, p. 28.

PG&E agrees that additional engagement and guidance from the Commission in setting priorities will be beneficial in shaping and maximizing the value of EPIC investments. In an effort to define a set of 3-5 Policy & Innovation Partnership Areas (PIPAs) within the EPIC III cycle, the Policy & Innovation Coordination Group (PICG) has developed a top-down framework of overarching goals, strategies for meeting those goals, and the associated obstacles and challenges in implementing those strategies. PG&E recommends that the Commission utilize this type of structured and comprehensive framework to identify priorities. As prioritizing among overarching goals will not be sufficiently granular, PG&E recommends that the Commission define priorities among the underlying strategies, or ideally even among the sets of obstacles and challenges in implementing the strategies.

c. What should be the process/cadence for revisiting these principles and priorities?

Priorities will change over time, and PG&E recommends that the Commission update whatever framework it establishes and its associated priority areas on an annual basis. PG&E looks forward to providing any support the Commission might need in conducting this process.

The Commission's updating of priorities will only be valuable to the extent the Administrators have the structural flexibility to realign with evolving priorities over the course of an investment cycle. Below in response to Issue 4a, PG&E recommends specific structural changes that will provide the Administrators the flexibility needed to maintain alignment between their EPIC programs and evolving priorities.

4. Administrative and Program structure improvements

- a. What other changes to the administrative structure of EPIC could benefit the program? Is the current administrative structure sufficient to balance responsiveness to emerging RD&D priorities with the need for oversight and transparency?*
- b. Should the Commission designate certain administrators or entities to certain administrative tasks or policy areas (e.g., would cybersecurity RD&D be best suited to a particular administrator or type of administrator)?*

- c. *Are any definition changes or clarifications to the three program areas (Applied Research and Development, Technology Demonstration and Deployment, and Market Facilitation) needed?*
- d. *Should the 10 percent cap on administrative expenses remain or instead be increased, due to increased administrative tasks?*

PG&E Response: As provided by PG&E's prior comments in this proceeding, the IOUs' administration of technology demonstration funding and projects should continue, subject to the improvements in metrics, reporting and collaboration approved in the IOUs' Research Administration Plan and D.20-02-003.⁸ Because technology demonstration projects need to be closely coordinated and integrated with the IOUs' individual electric grids, infrastructure investment plans, IT and cybersecurity systems, and customer tools and services, technology demonstration projects and funding should continue to be administered directly by the individual IOUs, not a separate or centralized administrator.

- a. *Are there changes to the current administrative structure of EPIC that could benefit the program? Is the current administrative structure sufficient to balance responsiveness to emerging RD&D priorities with the need for oversight and transparency?*

Through their Phase 1 Opening Briefs, each of the IOUs has detailed the significant value delivered through their respective EPIC programs through an expansive set of specific examples, as well as the ongoing work that will continue to deliver value in critically important areas such as renewables integration, decarbonization, resiliency and wildfire risk reduction.

Included as Appendix B to this Opening Brief is a comprehensive summary of benefits delivered by every single EPIC project PG&E has either completed or initiated as of August 2020. Of note in Appendix B is the additional quantification of projected benefits for EPIC projects 2.34 and 3.03, which total \$22M of savings per year. However, there are structural challenges and limitations in the current EPIC program that if addressed in this proceeding would enable the IOUs to deliver even greater value in the successor program.

⁸ D.20-02-003, Finding of Facts 2- 11, 13, 14, pp. 35- 37; Conclusions of Law 5, 7, p. 38; Ordering Paragraph 1, p. 39.

Flexibility in Investment Plan Execution: PG&E recommends that the IOUs' future investment plans be comprised of sets of initiatives, to align with the level of detail in the CEC's investment plans, and to greatly increase flexibility during investment plan execution. The Utilities are currently required to file sets of specific projects in their investment plan applications. During investment plan execution, to pursue any work that did not directly align with the specific project descriptions in their investment plan applications, the IOUs must request amendments to their investment plans through a formal and time-intensive Tier 3 advice letter process. The level of detailed required of the IOUs during investment planning, often years in advance of project initiation, and the limited avenue for modifying investment plans once approved, collectively result in almost no flexibility to respond in a timely manner to a rapidly evolving technology landscape or emergent needs and priorities during an investment cycle. For example, ideation to define the set of proposed projects to include in PG&E's EPIC 3 investment plan application began in 2016, and the investment plan was filed in April of 2017. The Commission did not approve the investment plan until October of 2018. Even when planning its first wave of EPIC 3 projects in late 2018 upon investment plan approval, there were already specific projects that had grown stale and lost relevance. By the time PG&E began planning its second wave of EPIC 3 projects in early 2020, very few of the remaining filed projects that had been defined nearly four years before were still relevant, and as a result PG&E is now in the process of developing a Tier 3 Advice Letter to propose several new projects that address emergent needs in critical areas such as resiliency and wildfire risk reduction. This is simply a sub-optimal model for conducting an RD&D program.

As proposed in the IOUs' Joint Opening Comments to the OIR,² the investment plans would define the scope of each initiative, along with brief descriptions of candidate projects that would be funded in each initiative. The initiatives would be outlined to provide

² Joint Opening Comments of SCE, PG&E and SDG&E, R.19-10-005, p. 9.

sufficient flexibility to make final project selections and adjustments to project scope within the bounds of the initiative. For example, in PG&E’s EPIC III investment plan, “Asset Health Monitoring” could have been defined as an initiative, and represented several projects in the investment plan that aim to leverage some combination of existing data, new sensors, new data, and new analytical techniques to better monitor the health of the grid. Projects from PG&E’s EPIC III investment plan such as 13, 16, 18 and 20¹⁰ could have been identified as candidate projects to provide further detail on the intended focus of the initiative, without constraining PG&E to conducting only these and no other emergent projects within the scope of the initiative. This flexibility is necessary for the EPIC Administrators to address the rapidly evolving threat of climate change and wildfire risk, respond to the dynamically changing backdrop of newly emerging technology solutions and policies, and maximize collaboration and leverage federal grant and co-funding opportunities.

Within the current structure, any federal grant or co-funding opportunities that arise during investment plan execution would have to coincidentally align with both the timing and scoping of specific projects from the investment plan to be pursued, and this is rarely the case. The Phase 1 Decision implemented the four Administrators’ recommendation to lengthen investment cycles from three years to five years. With longer cycles, it will be even more important to allow the IOUs to file their investment plans at the initiative level, as the CEC does now, to provide much-needed flexibility during investment plan execution. If the Commission adopts this recommendation, this should provide adequate improvements in flexibility without needing to also modify the Tier 3 Advice Letter process. If PG&E were to identify an entirely new initiative during investment plan execution that was not included in the investment plan, then adding the new initiative would be a significant enough change to justify the rigor and time-intensiveness of the Tier 3 Advice Letter process.

¹⁰ Application of Pacific Gas and Electric Company for Approval of its 2018-2020 Electric Program Investment Charge Investment Plan, A.17-04-028, p. 5.

PG&E understands that receiving this greater flexibility during investment plan execution in turn necessitates a high degree of information sharing and stakeholder engagement on the part of the EPIC Administrators in the course of selecting and scoping specific projects. Once an investment plan is approved, PG&E will share plans and budgets of candidate projects with stakeholders and conduct a public workshop to gather feedback and inform the final selection and scoping of projects before each wave of projects is launched. After each workshop, PG&E will post materials from the workshop on its website and include summaries of the feedback received from stakeholders and how it informed the selection and scoping of projects. This engagement will be in addition to the engagement that already takes place upstream during the investment planning process, as well as the Annual Symposium, Fall Workshop and other channels of engagement. Stakeholders will also have greater visibility into each Administrator's EPIC work through the joint EPIC database and associated public website that is currently being established through the PICG.

Access to Applied Research & Development: PG&E recommends that the IOUs be authorized to conduct projects in EPIC's Applied Research & Development (Applied R&D) investment category. The Utilities are currently only authorized to conduct projects in the downstream Technology Demonstration & Deployment (TD&D) investment category. As the IOUs stated in their Joint Opening Comments to the OIR, this limitation restricts the IOUs' technology pipeline, which would normally include work with technologies in earlier stages of development. This limitation, along with the issue of investment plan rigidity addressed above, have virtually eliminated the IOUs' ability to leverage their investments with federal grant opportunities and national and international research consortia that typically address a broader spectrum of the technology lifecycle than EPIC's TD&D investment category allows.¹¹

¹¹ Joint Opening Comments of SCE, PG&E and SDG&E, R.19-10-005, p. 5.

As stated in its Phase 1 Opening Brief and reiterated in its Opening Comments to the Phase 1 PD, PG&E remains very mindful of customer affordability and the impact of increasing electric bills, and recommends the successor program's overall funding level align with the current program's funding level.¹² If granted access to Applied R&D, PG&E would judiciously identify and fund targeted Applied R&D within its current budget allocation. Applied R&D work would be conducted with the goal of maturing concepts and capabilities that would then transition to specific TD&D projects, and grid resiliency and wildfire risk reduction are areas where it would be particularly beneficial to conduct targeted upstream Applied R&D.

Ability to Leverage External Funds: The two structural changes above, enabling flexibility during investment plan execution, and allowing the IOUs to conduct Applied R&D in addition to TD&D, would collectively open opportunities to pool some of EPIC's resources with resources from other utilities from around the country through various consortia, to co-fund R&D projects of common interest and applicability across utilities. As detailed in PG&E's Phase 1 Opening Brief,¹³ PG&E's Gas R&D program co-funds its R&D projects through consortia, and for every \$1 PG&E's Gas R&D program allocates to R&D via consortia, they leverage on average \$6 in co-funding from other utilities and organizations. There is likely to be greater opportunity to pool EPIC resources to co-fund Applied R&D than TD&D, as at this stage of development there will be broader applicability across a larger set of utilities, whereas TD&D projects will tend to involve more aspects that are specific to the implementation on a specific utility's grid. While there are no EPIC rules that directly prohibit co-funding and participation in consortia, co-funding will require a shift from the default position of outright IP ownership by the EPIC Utility Administrator, as IP would generally be shared among all consortium members.

¹² Phase 1 Opening Brief of Pacific Gas and Electric Company, R.19-10-005, p. 11.

¹³*Id.*, p. 10.

- b. Should the Commission designate certain administrators to certain administrative tasks or policy areas (e.g., would cybersecurity RD&D be best suited to a particular administrator or type of administrator)?*

As stated in response to Issue 2, without a common understanding among EPIC stakeholders of the specific flaws, or priority issues the Commission would like to see addressed, there will be no basis for assessing what reassignment or realignment of administrative tasks, if any, might be justified and advantageous. To the extent that there are specific improvements that the Commission would like to see implemented, beyond those already approved from the IOUs' RAP, it would be more appropriate to consider aligning or consolidating specific administrative functions among the four Administrators, than to have the CEC subsume the IOUs' programs entirely and take away the IOUs' direct administrative role.

PG&E does not see a need to change the designation of specific policy areas across Administrators. However, the IOU and CEC roles are distinct and complementary, and as such the amount of funding they allocate, and the nature of their projects will vary across policy areas. For each policy area, the Commission should consider how the IOU and CEC Administrators are expected to contribute, and in turn consider which of the three investment areas (Applied R&D, TD&D, Market Facilitation) they should have access to in order to maximize their contribution to the specific policy area. Instead of imposing overarching restrictions on the investment areas the IOUs are allowed to fund, making more granular determinations by combination policy area, administrator and investment area will enable delivery of even greater value.

The cybersecurity RD&D policy area called out specifically by the Commission in Issue 4b is an area where the Utilities had previously collaborated successfully to develop a foundation of capabilities through the California Energy Systems for the 21st Century (CES-21) Applied R&D program. The Utilities' unique expertise, access and resources allowed for these cyber tools and capabilities to be developed very specifically for electric grids.

Through CES-21, the Utilities demonstrated that they can deliver significant value not just in administering TD&D projects, but in administering Applied R&D as well.

- c. Are any definition changes or clarifications to the three program areas (Applied Research and Development, Technology Demonstration and Deployment, and Market Facilitation) needed?*

D.12-05-037 defines Technology Demonstration and Deployment as “The installation and operation of pre-commercial technologies or strategies at a scale sufficiently large and in conditions sufficiently reflective of anticipated actual operating environments to enable appraisal of the operational and performance characteristics and the financial risks.”¹⁴ Given this definition, PG&E recommends that a more representative title for this investment area would be “Technology Development and Demonstration.” The word “deployment” in the current title misleadingly implies that within this investment area, technologies are taken to a commercial level of maturity and deployed in production. Adding the word “development” is appropriate because although this investment area leverages and evaluates emerging technologies, development work and tailoring is typically still needed in preparation for the operational demonstration of the solution.

- d. Should the 10 percent cap on administrative expenses remain or instead be increased, due to increased administrative tasks?*

This issue is difficult to address without knowing what specific changes to administrative functions or even potentially overarching changes to the IOUs’ role will be implemented. However, as stated in its Phase 1 Opening Brief,¹⁵ PG&E has established rigorous administrative practices and has continually enhanced those practices over the course of the EPIC program. In committing to additional improvements through the IOUs’ April 2019 Joint RAP, PG&E aimed to efficiently address the intent of the Evergreen Evaluation’s recommendations, while ensuring that the resources required to administer its program would not exceed EPIC’s 10% administrative expenditure cap. Subsequently,

¹⁴ D.12-05-037, Ordering Paragraph 3, p. 100.

¹⁵ PG&E Phase 1 Opening Brief, R.19-10-005, p. 13.

participation in the new Policy & Innovation Coordination Group (PICG) has also drawn significant administrative resources. While PG&E recommends keeping the administrative budget cap at 10%, there is already considerable pressure on the administrative budget, and PG&E urges that in the course of this proceeding, the breadth of administrative requirements and practices in consideration be evaluated and prioritized for implementation in recognition of the administrative budget cap. Parties would benefit from having a jointly developed (Energy Division, IOUs and CEC) EPIC Program Administration handbook that clearly articulates the program's administrative requirements and standards to ensure alignment on expectations among the Commission and the Administrators.

5. *How should the Commission address recommendations from the Evergreen Evaluation that have not already been fully addressed? (Refer to Appendix B of D.18-10-052.)*

PG&E Response: The Evergreen Evaluation made 32 recommendations, of which 12 were addressed in the Utilities joint RAP Application. Attached as Appendix C to this opening brief are the remaining 20 recommendations from the Evaluation, along with PG&E's suggestions for how they should be addressed.

6. *Future program and administrator evaluations*

- a. *What metrics should be used in evaluating the program's success going forward?*
- b. *What other items should an evaluation consider?*
- c. *When should the evaluations take place?*
- d. *Who should conduct the evaluation?*
- e. *Should different metrics apply to different administrators?*
- f. *What are the consequences for underperformance?*

PG&E Response: PG&E recommends that program evaluations be conducted during the fourth year of the first five-year cycle and include benchmarking with all administrators, including the IOUs and the CEC. The evaluations should consider comparable criteria and metrics based on the characteristics of the different types of RD&D programs and projects administered by the IOUs and the CEC. The evaluations should be conducted directly by Commission staff, with support as necessary from competent, neutral consultants.

Recommendations for improvements coming as a result of such evaluations should be considered and implemented after an opportunity for comment by the IOUs, CEC and other stakeholders over a feasible period of time, similar to the improvements recommended by the joint IOUs in their Research Administration Plan and approved by the Commission in D.20-02-003.

a. What metrics should be used in evaluating the program's success going forward?

As PG&E suggested in its Prehearing Conference Statement,¹⁶ while project-level metrics can provide some indication of the value of the program, they are distinct from, and should not be used as a substitute for supplemental program-level metrics. PG&E recommends that this proceeding's public workshops be used to establish consensus among stakeholders on the set of program-level metrics to supplement the project-level metrics and information in the Administrators' reports for assessing the value delivered through EPIC. Representatives from peer utility R&D programs as well as R&D experts from other industries should be included in the workshops to inform the establishment of these metrics. Below are examples of program-level metrics that might be considered:

- The number of projects that were successfully transitioned to follow-on projects. Metrics might include the number of Applied R&D projects that transitioned to TD&D projects.
- The number or proportion of each Administrator's projects that have subsequently resulted in or informed commercial deployment, industry standards or operational use at a larger scale.
- The number or proportion of each IOU's projects that aim to address their highest-scoring operational risk areas.
- The number of instances where EPIC projects helped to conclude that specific technologies or solutions should not be further developed or deployed, and

¹⁶ PG&E Prehearing Conference Statement, R.19-10-005, p. 4.

thereby avoided costly endeavors. These are valuable insights whose benefits are difficult to quantify, but they are valuable nonetheless.

- The proportion of funding allocated to each program area, projects in each technology type, or projects that align to each relevant CA policy or CPUC proceeding.

b. What other items should an evaluation consider?

While the four EPIC Administrators collaborate regularly, it would be valuable for the evaluator to provide an outside perspective on specific high value-added administrative practices conducted by individual administrators that might be beneficial to the other administrators, with the goal of helping each administrator maximize their efficiency and effectiveness within their respective program and administrative budgets. In addition to identifying what is missing, or opportunities to add rigor and governance, the evaluator should also consider what current administrative practices might not be the most valuable expenditure of resources, as administrative requirements and governance tend to increase over time if not holistically evaluated from time to time. The evaluator should also critically examine the structure of the program and its administrative requirements, in addition to assessing the Administrators' performance within the framework.

c. When should the evaluations take place?

PG&E recommends that the evaluation be conducted and completed during the fourth year of the first five-year cycle. This would provide ample time for a robust evaluation with minimal risk of having to delay the approval of the second five-year cycle until program improvements are defined. PG&E recommends that the evaluation focus on both the first cycle of the successor program and the value delivered through the EPIC III cycle, as the previous evaluation did not address the EPIC III cycle.

d. Who should conduct the evaluation?

PG&E recommends that the evaluation be conducted by Commission staff, with support from outside consultants as needed to gather information, conduct industry benchmarking and perform analysis, as opposed to having an outside consultant lead the evaluation.

e. Should different metrics apply to different administrators?

To the extent that EPIC Administrators have different roles, administrative requirements, and access to different investment categories, different metrics may apply to different administrators. For example, a key success metric of the CEC's EPIC program is the amount of follow-on private investment received by companies that had received CEC EPIC funding. This is not a fundamental objective or outcome of IOU projects in the TD&D program area. Alternatively, an indicator of IOU success might be the number technologies from TD&D projects that went on to be deployed on the grid. This metric would not apply to the CEC, as their TD&D projects deploy behind-the-meter (BTM) customer solutions. This issue should be addressed as part of the workshop to define program level metrics.

f. What are the consequences for underperformance?

PG&E recommends that the program evaluation and its findings be treated as a collaborative effort between administrators and the Commission focused on continuous program improvement. While each of the EPIC Administrators has worked to continuously improve the efficiency and effectiveness of their programs, and each Administrator has detailed the significant value their programs have delivered, there will always be room for improvement. The consequence, or result, of the audit will be that numerous additional opportunities will be identified and will need to be prioritized for implementation in light of finite program and administrative budgets. PG&E looks forward to supporting the next program evaluation, whenever it might take place.

7. *Consideration of an interim investment plan filed by the CEC, in the event the agency files one.*

PG&E Response: PG&E will consider and comment on any interim investment plan filed by the CEC, when and if filed. As stated in its Reply Comments to the Phase 1 PD,¹⁷ PG&E supports the CEC's request, as long as similar advanced Commission approval is authorized for IOU advanced EPIC investment plans as well. Without an advance authorization of an interim PG&E EPIC investment plan, there will likely be at nearly a two year gap between the full commitment of PG&E's EPIC 3 funds and the ability to fund any new projects through the successor EPIC program.

III. CONCLUSION.

PG&E appreciates the opportunity to provide these comments and recommendations on the issues in Phase 2 of this proceeding.

Respectfully submitted,

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Dated: October 2, 2020

¹⁷ PG&E Phase 1 PD Reply Comments, p. 4.

APPENDIX A

**OPENING BRIEF OF PACIFIC GAS AND ELECTRIC
COMPANY (U 39-E) ON PHASE 2 ISSUES**

APPENDIX A

SUMMARY OF PG&E'S EPIC ADMINISTRATION FUNCTIONS

Below are the high-level sets of activities that comprise PG&E's administration of its EPIC program:

- **Investment Planning** – to develop a coordinated set of EPIC investments that address the most pressing needs and greatest opportunities for IOU innovation, and have the greatest likelihood of benefiting electric ratepayers
 - Lead the internal coordination, ideation and down-select process for candidate projects with SMEs across PG&E's Lines of Business
 - Coordinate with the other IOUs, and external organizations such as EPRI to ensure alignment and non-duplication
 - Socialize with stakeholders through a series of public workshops and incorporate feedback
 - Finalize and file investment plans
- **"Wave" Planning** – to identify the specific sets of projects within an investment plan that will be executed, and the timing of execution, once the investment plan is baselined
 - Once investment plans are approved, lead internal coordination to define subsets of filed projects or "waves" of projects to execute. This initial step considers factors such as the relative time-criticality of each project and the availability of specific personnel and other resources needed to execute each project
 - For second or third waves of projects, when the investment plan may have grown stale, this includes a bottom-up ideation and down-select of new candidate projects
 - Work with proposers and impacted stakeholders to flesh out projects into "1-pager" proposals and cost estimates
 - Facilitate leadership committee meetings to evaluate and score candidate projects against a broad set of defined criteria
 - Socialize the short-list of candidate projects with the public through a workshop, and incorporate their feedback into the 1-page summaries
 - Make final project selections, and develop/file a Tier 3 Advice Letter for any projects not already in the Investment Plan
- **Business Plan Development & Project Initiation** – to translate high-level project proposals into comprehensive/detailed project plans, ensure there is a clear path forward if the project is successful, and ensure all stakeholders support the project as defined and have committed the resources needed for execution
 - Work with teams to translate 1-page project summaries developed during wave planning into full business plans. Business plan content includes:
 - Value proposition
 - Objectives and scope

- Cost breakdown
 - Project success metrics and benefits estimates
 - Dependencies and risks
 - Identification of impacted stakeholder groups
 - The ultimate path to production and solution owner if the project is successful
- Socialize business plans with all impacted stakeholders and facilitate formal approval of project initiation
- Release financial order numbers to allow teams to begin incurring project expenses
- **Sourcing and Contracting** – to define the external vendor support needed for project execution, identify the best-suited vendor partners, and develop and execute cost-effective contracts for the needed services
 - Coordinate with project teams to further define sourcing needs and developing the appropriate sourcing strategies. Sourcing strategies may include:
 - Requests for Information
 - Requests for Proposals
 - Direct Awards
 - Work with project teams to execute their sourcing strategies
 - Facilitate RFI/RFP processes, assist in RFP scorecard development & scoring, scrutinize and approve/reject direct award proposals
 - Actively facilitate resolution of any vendor issues with standard EPIC contract terms & conditions
 - Ensure coordination between project teams and vendors to determine IP ownership (who is bringing what IP into the engagement, and who owns what is incrementally produced through EPIC)
- **Benchmarking** – ongoing activities to inform the selection, scoping and any in-flight adjustments to our projects, and ensure avoidance of any unnecessary duplication with the efforts of other organizations
 - Benchmarking with the CA IOUs and CEC
 - Benchmarking with other utilities and the vendor community
 - Benchmarking with EPRI (formally during investment planning and wave planning)
 - Scanning the external landscape for new and promising technology solutions
- **Intellectual Property Coordination** – ongoing activities to ensure that the intellectual property generated through EPIC projects is applied to the maximum benefit of the ratepayers that fund the program
 - Coordinate with project teams to identify key IP associated with EPIC project
 - Coordinate with project teams and PG&E's New Revenue Development (NRD) group to identify protection strategy, file patents, develop licensing agreements, etc.
- **Positioning Technologies for Post-EPIC Adoption** – ongoing activities, starting during business plan development and through the project lifecycle, to ensure the technology or solution developed through the EPIC project will be successfully transitioned into production or deployed at a wider scale after the conclusion of the EPIC project

- Ensure that the end users and all impacted stakeholder groups of the technology solution have been identified and are committed
- Ensure that alignment with end users and stakeholders is maintained throughout the project lifecycle as the scope may evolve or stakeholders transition roles
- As the project nears completion, ensure that project teams detail the required post-EPIC work on the technology or solution, how it will be funded, what roles and process will need to be modified, and what training and change management will need to be conducted
- Ensure planned post-EPIC project work and deployment is appropriately incorporated during General Rate Case development
- **Project Closeout** – to ensure that comprehensive final reports are developed to inform external stakeholders of the work that was done, the results, benefits, key takeaways and lessons learned, and next steps for the technology after the conclusion of the EPIC project
 - Work closely with project teams to develop comprehensive final reports to be released to the public on PG&E’s website and filed with the EPIC Annual Report
 - Work closely with project teams to develop supplemental closeout documentation on the detailed post-EPIC path to production for internal execution, and quantification of benefits
- **Financial Management** - ensure project teams effectively plan their project costs and incur costs in alignment with those plans, and ensure the program does not exceed overall budget or administrative spend cap
 - Lead annual program-level budget forecasting
 - Actively monitor and manage program-level budget and administrative spend to ensure compliance
 - Ensure project-level budget tracking and forecasting
 - Oversee project-level budgets and expenditures to ensure funds are being spent efficiently
 - Execute CEC and CPUC remittance payments
 - Execute PICG contract payment facilitation
- **Communications & Coordination** – ongoing activities to keep the broader stakeholder community aware of our program and projects and incorporate their feedback, align with the RD&D work of other parties, and offer formal support and commitment to parties bidding on CEC or federal grant solicitations
 - Actively participate in the PICG and PIPAs as core members
 - Develop, maintain and execute central EPIC communications plan in coordination with project teams (publications, articles, press releases, conference presentations, etc.)
 - Coordinate and co-facilitate EPIC Symposium & Fall Workshop
 - Conduct additional public workshops before every new wave of EPIC projects is launched, to inform stakeholders of our plans and incorporate their feedback into those plans
 - Conduct quarterly check-ins with Energy Division

- Develop responses to formal and informal CPUC data requests
- Host internal monthly director-level leadership committee meeting to ensure the portfolio of projects is on track and meeting highest-priority objectives
- Compile internal monthly dashboard reports on project status and health, and communicate with internal stakeholders
- Engage with a wide range of parties that bid on CEC or federal government grants to offer letters of support and commitment
- Maintain PG&E's EPIC website with up-to-date program and project information, and make periodic enhancements to website design and usability
- Develop and file comprehensive EPIC annual report, with updates on program status, key accomplishments, and next steps
- **Program/Portfolio Management** – Miscellaneous administrative functions that are critical to program success
 - Ensure that program administration and project execution comply with all CPUC program requirements
 - Identify and manage any project interdependencies, and help project teams clear any internal and external roadblocks during execution
 - Project change control – identify the need for, and help to socialize and approve any proposed scope, schedule or budget changes from the projects' baselined business plans
 - Act as the central point of coordination with PG&E's IT department, for the support IT provides to the portfolio of PG&E EPIC projects

APPENDIX B

**OPENING BRIEF OF PACIFIC GAS AND ELECTRIC
COMPANY (U 39-E) ON PHASE 2 ISSUES**

APPENDIX B

SUMMARY OF PG&E EPIC PROJECT BENEFITS

Preliminary Benefits Table

Project	CPUC Proceedings Supported	Market Products Influenced	Industry Standards Informed	Transitioned to Production or GRC Capital Requested	Increase Safety	Improve Reliability	Reduce Costs	Complementary Benefits
EPIC 1								
1.01 - Energy Storage End Uses	✓	✓		✓				✓
1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	✓	✓		✓			✓	✓
1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	✓			✓	✓	✓	✓	
1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	✓			✓	✓	✓	✓	
1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching		✓		✓	✓	✓		
1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs		✓			✓		✓	
1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors		✓		✓	✓	✓	✓	
1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	✓	✓		✓	✓	✓	✓	
1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future				✓	✓	✓		
1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	✓			✓		✓	✓	✓
1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information				✓			✓	
1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform				✓		✓	✓	
1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	✓			✓	✓	✓	✓	
1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	✓	✓	✓			✓	✓	
1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	✓					✓	✓	✓
1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	✓			✓		✓	✓	
1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	✓	✓				✓	✓	✓

Preliminary Benefits Table

Project	CPUC Proceedings Supported	Market Products Influenced	Industry Standards Informed	Transitioned to Production or GRC Capital Requested	Increase Safety	Improve Reliability	Reduce Costs	Complementary Benefits
EPIC 2								
2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	✓	✓		✓	✓	✓	✓	✓
2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	✓		✓	✓		✓	✓	✓
2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	✓	✓			✓	✓	✓	✓
2.04 - DG Monitoring & Voltage Tracking	✓					✓	✓	✓
2.05 - Inertia Response Emulation for DG Impact Improvement	✓			✓		✓	✓	✓
2.07 - Real-Time Loading Data for Distribution Operations and Planning				✓	✓	✓	✓	
2.10 - Emergency Preparedness Modeling					✓	✓	✓	
2.14 - Automatically Map Phasing Information	✓			✓	✓	✓	✓	✓
2.15 - Synchrophasor Applications for Generator Dynamic Model Validation				✓		✓	✓	
2.19 - Enable Distributed Demand-Side Strategies & Technologies	✓			✓		✓	✓	✓
2.21 - Home Area Network (HAN) for Commercial Customers							✓	✓
2.22 - Demand Reduction through Targeted Data Analytics	✓			✓		✓	✓	✓
2.23 - Integrate Demand Side Approaches Into Utility Planning	✓			✓	✓	✓	✓	✓
2.26 - Customer & Distribution Automation Open Architecture Devices				✓		✓	✓	
2.27 - Next Generation Integrated Smart Grid Network Management				✓	✓	✓	✓	
2.28 - Smart Grid Communications Path Monitoring							✓	
2.29 - Mobile Meter Applications	✓				✓		✓	✓
2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	✓	✓		✓	✓	✓	✓	
2.36 - Dynamic Rate Design Tool							✓	✓

Preliminary Benefits Table

Project	CPUC Proceedings Supported	Market Products Influenced	Industry Standards Informed	Transitioned to Production or GRC Capital Requested	Increase Safety	Improve Reliability	Reduce Costs	Complementary Benefits
EPIC 3								
3.03 - Advanced DERMS and ADMS	✓	✓	✓	✓	✓	✓	✓	✓
3.11 - Location Targeted DERs	✓	✓	✓		✓	✓		✓
3.15 - Proactive Wire Down	✓	✓	✓	✓	✓	✓	✓	
3.20 - Maintenance Analytics	✓	✓		✓	✓	✓	✓	
3.27 - Multi Purpose Meter	✓		✓	✓	✓	✓	✓	✓
3.32 - System Harmonics	✓	✓	✓	✓		✓	✓	
3.41 - Drone Enablement	✓		✓	✓	✓	✓	✓	
3.43 - Momentary Outage Information	✓	✓		✓	✓	✓	✓	

Preliminary Benefits Table

EPIC 1.01 - Energy Storage End Uses

This project successfully utilized PG&E's Vaca-Dixon and Yerba Buena Battery Energy Storage Systems (BESSs) to gain experience and data by participating in CAISO's Non-Generator Resource (NGR) market model. PG&E developed and deployed a foundational automated communications and control solution to fully utilize and evaluate BESS fast-response functionalities.

CPUC Proceedings Supported:

- R.15-03-011, Energy Storage Procurement Program
- D.12-08-016, adopting Proposed Framework for Analyzing Energy Storage Needs

Market Influence: Introduced the first utility-owned battery storage resources into the NGR market. Learnings formed foundation for additional storage agreements through the Storage OIR. The project also helped CAISO identify and resolve multiple implementation issues with the NGR market model and enhance that model in ways that will significantly benefit future market participants.

Transitioned to Production or GRC Capital Requested: The two batteries from the demonstration continue to operate in production with the CAISO market (4 MW Yerba Buena in San Jose, 2 MW Vaca-Dixon in Vacaville). The project also provided insights and lessons on how to improve operations for the 2020 GRC, Chapter 19: Grid Modernization; specifically, for Advanced DMA Platform and SCADA Replacement investments.

Benefits:

- A. **Complementary Benefits:** Directly and indirectly addressed multiple barriers to energy storage for the benefit of current and future CAISO market participants.

EPIC 1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction

This project demonstrated the ability of a utility-owned and controlled energy storage resource to deliver autonomous distribution peak shaving functionality. Energy storage resources hold significant promise to help California address a variety of grid planning and operations challenges, both today and in the future, and can be used to provide more reliable and clean power to customers for lower overall costs. The learnings from this project can help inform utility procurement and operation of future energy storage resources, both utility-owned and utility-contracted, through compliance with the IOU energy procurement targets as set forth in CPUC D. 10-03-040 and beyond.

CPUC Proceedings Supported:

- R.15-03-011, Energy Storage Procurement Program
- D.12-08-016, adopting Proposed Framework for Analyzing Energy Storage Needs
- D.10-03-040, establishing IOU energy procurement targets
- R.14-10-003, Integrated Distributed Energy Resources

Preliminary Benefits Table

- R.14-08-013, Distribution Resources Plans

Market Influence: Learnings formed foundation for additional storage agreements through the Storage OIR.

Transitioned to Production or GRC Capital Requested: The battery from the demonstration continues to operate in production at Browns Valley substation and provide peak load shaving. This has enabled deferral of distribution upgrades that would have cost approximately \$1M. The project also provided insights and lessons on how to improve operations for the 2020 GRC, Chapter 19: Grid Modernization; specifically, for Advanced DMA Platform and SCADA Replacement investments.

Benefits:

- A. **Reduce Costs:** The deployment of just one ~30MW energy storage solution for grid services in place of a transmission system upgrade has the potential to provide \$5-15M in cost savings.
- B. **Complementary Benefits:** To the extent energy storage resources can be used to replace natural gas based generation for peak power generation, and to the extent those energy storage resources are charged with low-carbon electricity, energy storage systems can reduce the net GHG emissions from the electricity sector.

EPIC 1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output

This project successfully developed and demonstrated a new mesoscale meteorological model to provide more granular and accurate weather forecasting input to PG&E's storm damage prediction model and to other PG&E forecasting applications, such as catastrophic wildfire risk, large storms and photovoltaic (PV) generation. This model has improved the accuracy of forecasting for large storms, allowing for increased efficiencies in storm preparation, as well as enhanced the accuracy of identifying fire risks, helping enable improved reliability and safety. Finally, leveraging granular solar irradiance data in a new framework has improved PG&E's ability to understand the impacts of PV generation for grid management.

CPUC Proceedings Supported:

- R.18-10-007, requiring the IOUs to develop Wildfire Mitigation Plans

Transitioned to Production or GRC Capital Requested: Systems were transitioned to full production and operational use. The improved Fire Danger Rating System developed through the project served as the basis for PG&E's current Fire Potential Index.

Benefits:

- A. **Increase Safety:** The higher resolution weather model outputs (from 12km to now 3km) to various PG&E planning and operations activities provides improved situational awareness of anticipated hazardous conditions and facilitates the effective use of standby emergency responses. Increased accuracy of fire danger rating information leads to improved public and employee safety.
- B. **Improve Reliability:** The improved prediction of storms and resulting damage will help in storm response planning and faster restoration after events.
- C. **Reduce Costs:** Better forecasts of storms and impacts will enable improved planning and more efficient restoration and repair after events.

Preliminary Benefits Table

EPIC 1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques

This project demonstrated a visualization and decision support system called System Tool for Asset Risk (STAR) to support PG&E's risk management efforts to enhance public and system safety, as well as improve asset management strategies and investment plans.

CPUC Proceedings Supported:

- Risk Assessment Mitigation Phase (RAMP) of General Rate Cases

Transitioned to Production or GRC Capital Requested: After project completion, the STAR tool was enhanced through the 2017 GRC and deployed in production. Using STAR, asset managers can more effectively evaluate system safety, aging infrastructure issues and system reliability and comply with regulatory requirements.

Benefits:

- Increase Safety:** The scoring of individual asset and system risk through the STAR tool helps to enable focusing on higher risk assets, and the identification of work that has the greatest likelihood of improving public safety.
- Improve Reliability** The STAR platform developed through this project provides improvements to the calculation and visualization of asset system risk, which in turn enables the development of improved asset strategies to improve system reliability.
- Reduce Costs:** Improvements in the asset risk quantification improve prioritization of risk mitigations and enable more efficient allocation of resources and cost reduction.

EPIC 1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching

This project focused on increasing system reliability and improving the safe operation of three-phase Load Break Oil Rotary switches, which are used for making or breaking the path in an electrical circuit. In both a lab and field setting, this project successfully demonstrated and evaluated various robotics that would allow PG&E workers to remotely operate certain subsurface or underground (UG) oil switches.

Market Influence: All three vendors demonstrated in the project have now commercialized the technology. Recommended modifications and improvements to the vendor products for ergonomics and ease of use, such as making reflective lights more visible to the operator when operating from far away.

Transitioned to Production or GRC Capital Requested: After project completion, transitioned to production and began broader-scale rollout of additional units across the service territory through the GRC.

Preliminary Benefits Table

Benefits:

- A. **Increase Safety:** By developing a handheld remote-controlled tool to open and close underground rotary oil filled switches, workers and the public can be placed a safe distance away in the event of a failure. PG&E will no longer operate these switches without this tool due to the safety value.
- B. **Improve Reliability:** The project enhances system reliability by reduced outage time in the event of a failure.

EPIC 1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs

This project successfully demonstrated methods of evaluating and potentially extending the longevity, resiliency and data integrity of Supervisory Control and Data Acquisition (SCADA) condition-monitoring components over time. The overall strength of the monitoring and communication systems currently installed across the distribution network was confirmed and methods for improving the life and data integrity of its components were demonstrated. Real-time condition monitoring of this system provides a key input to support proactive mitigation of equipment-related issues.

Market Influence: Worked with the manufacturer of the SCADA system's Remote Terminal Unit (RTU) expansion board to improve sensor data integrity.

Benefits:

- A. **Increase Safety:** Ambient temperature and oil sensors are designed to alarm upon conditions such as overheating of the equipment. Overheating could result in asset failure, potentially resulting in a safety risk. A well-functioning monitoring system reduces this safety risk.
- B. **Reduce Costs:** Extending the life of condition monitoring equipment may reduce the life cost of installation, maintenance, repair and replacement of this equipment. Additionally, being aware of potential problems with network equipment helps PG&E respond to required repairs before asset failures occur can potentially reduce the overall cost of operating the distribution network system by extending the life of major assets.

EPIC 1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors

This project successfully demonstrated new Discrete Series Reactor (DSR) technology deployed directly onto transmission conductors to detect potential overloads and increase line impedance to shift this load to parallel facilities. These devices can potentially enable optimization of line flows, mitigation of overloads, and delay of costly new transmission line or reconductoring projects.

Market Influence: Collaborated with technology provider who leveraged project results to support the development of a new technology that is expected to provide an even greater reduction in line flow while leveraging the same Discrete Series Reactor (DSR) firmware and software.

Preliminary Benefits Table

Transitioned to Production or GRC Capital Requested: Installed 90 DSRs on the Los-Positas Newark 230kV transmission line, which reduced line flow and balanced the three phases. PG&E has adopted the DSRs as a part of the Transmission options to be considered when reviewing capacity needs.

Benefits:

- A. **Increase Safety:** Transmission line overloads can potentially cause asset damage or create a safety hazard with the line. DSRs can be deployed directly onto transmission conductors to detect potential overloads and increase line impedance to shift this load to a lower load conductor.
- B. **Improve Reliability:** Some PG&E transmission lines experience overloads following n-2 or n-1-1 outages that are mitigated by the use of Special Protection System (SPS) load tripping. The use of DSRs on such a line could reduce the need for SPS load tripping, thereby potentially reducing reliability impact.
- C. **Reduce Costs:** Currently, mitigation of transmission line overloads often leads to investments to increase capacity such as reconductoring the line. DSRs could be implemented to defer the need for a higher cost transmission capacity upgrade, reducing the cost of overload mitigation. As compared to traditional transmission investments, DSRs can be deployed several years faster at a significantly lesser cost. Additionally, DSRs offer portability and flexibility, whereas traditional upgrades are permanent installations.

EPIC 1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)

This project evaluated the radio mesh telecommunications network that connects SmartMeter™ devices across PG&E's territory, including demonstration of new potential use cases for that network. The project created a methodology to determine available bandwidth, tested a variety of smart grid devices to demonstrate their potential to leverage the network for communications, and demonstrated potential enhancements to the existing outage reporting capabilities of SmartMeter™ devices.

CPUC Proceedings Supported:

- R.18-10-007, requiring the IOUs to develop Wildfire Mitigation Plans

Market Influence: This project developed significant intellectual property, as well as multiple patents and license agreements with external vendors. For example, this project developed the foundation for the capability to use the SmartMeter™ network to monitor for partial voltage conditions that are indicative of wires down events. PG&E is both deploying this capability in production internally, and has licensed this capability to a large vendor, who will in turn provide it to potentially numerous other utilities. Also, the “Smart Pole Meter” developed in the project, which allows PG&E to appropriately meter telecom equipment attached to streetlights, has been patented and licensed to two vendors, enabling future revenue for PG&E when cities partner with these vendors to become “Smart Cities” with expanded connectivity.

Transitioned to Production or GRC Capital Requested: The partial-voltage wire down detection capability, which is an extension of this project, is being deployed at scale across PG&E’s service territory. The Restoration Dashboard was transitioned to production,

Preliminary Benefits Table

and the Smart Pole Meter has been deployed at limited scale, including in the city of San Jose. The project also provided insights and lessons about how to improve operations for 2020 GRC, Chapter 6: Metering.

Benefits:

- A. **Increase Safety:** The partial-voltage wire down detection capability allows for automated detection of wires down events through the SmartMeter™ network, and faster resolution to minimize the risk to the public.
- B. **Improve Reliability:** Demonstrated technologies that may provide greater reliability through potential improvements in outage reporting, distribution automation control and telemetry, and monitoring and control of the electric grid.
- C. **Reduce Costs:** Leveraging the SmartMeter™ Network for non-metering applications and devices (that would otherwise require a separate communications network) has the potential to lower costs for smart grid devices and applications that can help PG&E to deliver energy safely and efficiently. Innovative metering solutions such as Smart Streetlights and Smart Pole Meter can enable PG&E to more accurately meter electricity use. The partial-voltage wire down detection capability was patented, and subsequently licensed, with the potential for significant royalties over the next five years that will be returned to customers.

EPIC 1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future

This project demonstrated a technology platform to visualize grid operations data to improve both real-time and short-term operational decisions, such as outage anticipation, construction planning, circuit loading research, and emergency operations. The project developed key data, system, and user experience learnings through integrating more than 20 data sources into a single visualization tool allowing users to view complex data sources in ways that were not possible through current solutions. This project formed the foundational learnings which will allow PG&E to potentially explore other complex situational awareness tools and applications to allow users to target information to help manage changes on the grid.

Transitioned to Production or GRC Capital Requested: GOSI learnings were combined into GridApps data and analytics platform including STAR – System Tool for Asset Risk from EPIC 1.08.

Benefits:

- A. **Increase Safety:** The Distributed Generation Research, Circuit Loading Research, and Outage Anticipation use cases could allow operators to identify potentially dangerous reverse power flow from distributed generation assets during circuit outages.
- B. **Improve Reliability:** The information displayed on the Interactive Map and the Outage Anticipation use case could enable grid operators to dispatch resources more effectively. Access to better and fresher data could support more effective early warnings, reduce power quality complaints, and accelerate power restoration activities.

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EPIC 1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages

This project successfully developed and demonstrated a new Vehicle On-Site Grid Support System (VOGSS), for utility-grade power export from Plug-in Hybrid Electric Vehicle (PHEV) fleet trucks. This new technology enables a source of mobile power that can connect directly to distribution circuits, minimizing the impact of an outage for common preventative maintenance tasks such as transformer replacements. Additionally, VOGSS can provide power to facilities in emergency events, maintaining or quickly restoring service to customers.

CPUC Proceedings Supported:

- R.13-11-007, Alternative-Fueled Vehicles Programs

Transitioned to Production or GRC Capital Requested: Through the project, developed nine custom built trucks of four different power export capabilities (Pickups = 50kVA or 75 kVA, Bucket Trucks = 120 kVA, Flatbed = 160kVA). This fleet of trucks was transitioned to operations at project completion.

Benefits:

- Improve Reliability:** This project was executed to explicitly enable more resilient and reliable power through the substitution of truck exported power for the utility grid when a planned shutdown is needed. When the grid is down from unplanned events, VOGSS can help enable with localized re-energizing prior to a future permanent repair.
- Reduce Costs:** VOGSS leverages a multi-function tool used in lieu of either greater outage exposure or increased investment in dedicated generator sets (less capital efficient to buy another stand-alone equipment asset). Additionally, EPIC 1.16 supports the case for leveraging electric vehicles in utility fleets. Cost savings are primarily accounted from the operating savings from a plug-in hybrid electric drive system. The drive system exploits the use of lower-cost stored grid electricity as an offset to more expensive exclusively fossil-fuel-based mobility.
- Complementary Benefits:** VOGSS offers a cleaner alternative to fossil-fuel based backup generation.

EPIC 1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information

This project conducted a demonstration to understand and compare disaggregation vendors' ability to itemize monthly appliance-level usage for residential customers, as well as their current analytical capability and accuracy of their energy disaggregation software. Additionally, this project surveyed customers to understand their perception of the end-use energy presentations and the value of the disaggregated data.

Transitioned to Production or GRC Capital Requested: This demonstration identified key limitations in vendors' abilities to itemize usage and proved that disaggregation technology is not ready for a full-scale customer offering.

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Benefits:

- A. **Reduce Costs:** This demonstration identified limitations in vendors' abilities to itemize usage. Upon the improvement of the load disaggregation capabilities, customers will be able to more effectively manage their usage and ultimately, lower their electricity costs by understanding the underlying drivers of their electricity usage. Additionally, the learnings from disaggregated billing can be used to inform program and product designs for energy efficiency, demand response, and other programs, which may produce lower costs to customers.

EPIC 1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform

This project successfully demonstrated new ways to leverage the SmartMeter™ platform to provide greater visibility and granularity to additional SmartMeter™ data. The project proved the ability to collect power quality data and potentially enable a proactive response to address customer satisfaction concerns on voltage issues. The project also connected difficult to reach meters to the AMI network to potentially reduce manual meter reading operation and maintenance costs. Finally, the project improved the ability to identify 'Line Side Tap' scenarios to improve the efficiency and effectiveness of investigating energy diversion cases and to mitigate safety hazards for customers, the public or PG&E.

Transitioned to Production or GRC Capital Requested: Through the project, deployed and demonstrated antennas in the field to capture SmartMeter™ data for hard to reach customers and continued broader rollout of antennas via the GRC after the EPIC project.

Benefits:

- A. **Improve Reliability:** Giving visibility to more granular voltage data than was previously available assists in meeting CPUC Electric Rule 2 voltage service requirements for both line-to-line and line-to-neutral voltages. Meeting the voltage requirements allows the customer and utility equipment to operate properly and reduces potential damage from over- or under-voltage
- B. **Reduce Costs:** Radio communications technologies that provide the AMI network with a longer range allows over-the-air operations rather than field visits for those meters that were outside of the AMI network coverage. This eliminates the cost of monthly manual meter reading, as well as the need for ad-hoc visits.

EPIC 1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability

This project focused on developing and demonstrating technology to identify existence of PV systems using SmartMeter™ and other data not otherwise recorded in PG&E's interconnection database. Additionally, the project explored the ability of detecting underperforming or malfunctioning PV systems. The project was able to develop key inputs necessary to identify a PV system, filter for those identified systems with unauthorized interconnections, support high quality interconnection records by validating the size of PV systems, understand the limitations in the ability to detect if a PV system is underperforming or not functioning, and established a process to engage with solar customers to provide appropriate notice.

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CPUC Proceedings Supported:

- R.11-09-011, Rule 21, Smart Inverter
- R.17-07-007, Streamlining Interconnection of Distributed Energy Resources and Improvements to Rule 21

Transitioned to Production or GRC Capital Requested: The PV detection algorithm developed in the project successfully identified 53 suspected unauthorized interconnections (UIs) out of a sample of 72,306 customers used for the project, with model precision of 98.52%. Subsequent to the EPIC project, the algorithm was applied across the service territory, and identified over 2000 suspected UIs, which facilitated PG&E's coordination with these customers.

Benefits:

- A. **Increase Safety:** The algorithms developed by this project accurately predicted PV system sizes as well as unauthorized interconnections. Customers without an authorized interconnection may pose a risk to the components of the equipment and facility of the customer. Equipment failure can happen to various DG components, such as PV modules, inverters, circuit combiner, disconnecting, protection devices, and connectors. Equipment faults or over-heating can also ignite the combustible materials near the generator, causing fire damage to equipment and property.
- B. **Improve Reliability:** The algorithms developed by this project accurately predicted PV system sizes as well as unauthorized interconnections. Underreported or inaccurately reported interconnections could lead to voltage fluctuation problems or Rule 21 violations, as well as other reliability and planning issues. Improving the accuracy of known PV interconnections, sizing and performance can improve the ability to identify root causes for voltage fluctuations. Additionally, reliably predictable generation profiles at geographically granular levels are essential for forecasting and planning purposes to proactively plan system upgrades or deferrals, if needed.
- C. **Reduce Costs:** By detecting that an existing solar customer has an unauthorized interconnection, PG&E enables customers to participate in the Net Energy Metering (NEM) rate, reducing customer costs.

EPIC 1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility

This project was part of a California Statewide effort to demonstrate and evaluate the use of Electric Vehicle (EV) submetering to provide EV owners access to electricity at a less expensive electric rate—without having to install an additional utility meter to an existing service. This project also assessed EV customer demand for submetering and the customer experience with submetering.

CPUC Proceedings Supported:

- Decision 13-11-002, on utility requirements for the development of the Submetering Protocol
- R.13-11-007, Alternative-Fueled Vehicles Programs

Market Influence: PG&E identified key elements of third-party EV submetering solutions that will need to be improved before they are deployed to serve the state of California.

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Standards Influence: The project's findings and conclusions will to help inform the Commission's position on submetering protocol going forward.

Benefits:

- A. **Improve Reliability:** Subtractive billing via third-party submetering has the potential to improve the monitoring and management of EV charging load, which can contribute to improved system reliability. However, EPIC 1.22 has shown that the demonstrated approach to EV submetering is not ready to scale to the entire state and thus these reliability benefits are not yet able to be realized.
- B. **Reduce Costs:** The successful use of EV submetering via charging stations could reduce the cost of EV charging, however the costs savings—an average of \$374 per installation—are modest as compared to installing a second utility-grade meter and may not produce any ongoing bill savings when compared to alternative TOU rates. At the same time, to scale submetering to customers across California will cost the utilities from \$3,215,000 to \$5,000,000 per utility. This demonstration identified that third-party EV submetering solutions were not ready to be deployed to serve the state of California, and thus this project helped to avoid the substantial cost associated with the statewide rollout of such a solution.

EPIC 1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility

This project focused on developing, testing, and validating a way of collecting or estimating solar generation output data and enabling a subset of customers to view their estimated solar generation data through integration with PG&E's YourAccount website. Upon determining that using estimated PV generation data would be a viable option, the project also assessed the accuracy of the algorithm used by a third-party vendor. The project determined that additional data is necessary to develop a scalable PV generation estimate, including shading impacts, PV system tilt and azimuth, as well as weather data like fog and marine layer.

CPUC Proceedings Supported:

- R.14-08-013, Distribution Resources Plans
- R.14-10-003, Integrated Distributed Energy Resources

Benefits:

- A. **Improve Reliability:** While the project identified limitations in the existing data quality, once resolved the estimated PV generation data identified in this technology demonstration project may help PG&E understand the changing base load characteristic resulting from increased PV generation. It may also provide planners with more detailed and accurate information to better understand the gross load to properly account for actual demand on specific assets. The data could also be useful for distribution operators to more accurately quantify load masking and generate more accurate predictions of expected PV generation for short term forecasting. This could potentially help improve the distribution planning process and energy procurement.
 - B. **Reduce Costs:** The use of estimated generation is more cost effective than installing submeters for PV applications or paying for the data from a third-party solar provider. Customers can also have a better understanding of their individual PV systems with respect to their energy usage.
- Complementary Benefits:** Providing PV generation to customers allows them to understand the impact of their generation on their individual

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energy usage especially when combined with time of use metering and disaggregated load information. This could ultimately help customers be more efficient energy users.

EPIC 1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction

This project successfully provided and tested the performance of a near real-time window of PG&E's Air Conditioning (AC) Direct Load Control (DLC) system, which utilizes one-way switch control devices. This allowed us to improve our ability to estimate AC DLC impacts at the distribution system level to better understand the localized impact of AC direct load control devices on meeting distribution feeder level reliability concerns. It also enabled near real-time visibility of AC direct load control installations to support Transmission and Distribution (T&D) Operations and provided Demand Response (DR) program administrators with near real-time feedback on any problems with direct load control devices before, during or after an event is called, which supports T&D operational improvements.

CPUC Proceedings Supported:

- A.12-07-004, Demand Response (DR) Incentives
- A.14-06-001, Demand Response (DR) Change in Tariff Rules
- R.13-09-011, Demand Response (DR)

Transitioned to Production or GRC Capital Requested: 586 data loggers were installed on or near the sampled outdoor A/C units in the project's target area. After project completion, the SmartAC Program continued to use the deployed data loggers to actively monitor program impact.

Benefits:

- Improve Reliability:** Near real-time visibility into program performance advances a strategic objective to utilize DR resources not only to displace generation capacity, but also to support transmission and distribution grid reliability and improve performance of load control programs. This could be particularly important in the context of the increasing need to support renewables integration onto the distribution grid.
- Reduce Costs:** The near real-time visibility and data collected by the data loggers can be used to reduce program operation costs and potentially reduce T&D infrastructure costs.

EPIC 1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid

This project addressed Electric Vehicle (EV) adoption barriers by identifying optimal locations within PG&E's territory for the placement of DCFCs based on factors such as cost, available service transformer capacity, traffic patterns, as well as site host and driver preference. PG&E worked with industry experts to identify the 300 locations of highest unmet public charging need, forecasted out to 2025. Using a variety of inputs, including publicly-available business listing data, PG&E's distribution network to assess

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available distribution capacity, results from expert interviews, and PlugShare's database on existing public charging locations, the team then identified over 14,000 individual potential charger host sites, such as businesses, parking lots, and public places. The results of the project were developed into an interactive online map that visualizes the 300 optimal DCFC locations. The publicly-available map is accompanied by guidelines in the final report surrounding best practices for siting DCFCs developed to further encourage EV adoption by drivers, site hosts, and developers.

CPUC Proceedings Supported:

- R.13-11-007, Alternative-Fueled Vehicles Programs
- R.18-12-006, Development of Rates and Infrastructure for Vehicle Electrification (DRIVE)

Market Influence: The tools developed in this project helped enable PG&E to engage with OEMs and state stakeholders to help facilitate planning and siting of DCFCs. In addition to posting the interactive map on its EPIC website, PG&E has sent the siting tool to over 30 different external stakeholders upon request since project completion.

Benefits:

- A. **Improve Reliability:** By providing recommended site locations based on available transformer capacity, PG&E guides developers to install DCFCs in locations that would mitigate capacity overload or upgrades.
- B. **Reduce Costs:** The report identifies distribution upgrades as a major cost driver for DCFC installers. By identifying site hosts with and without distribution capacity, PG&E can assist in saving the time and money from future potential installers by identifying site hosts that have available capacity.
- C. **Complementary Benefits:** This project developed capabilities to support the deployment of charging infrastructure, which furthers the overarching goal of clean transportation.

EPIC 2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)

This project provided an opportunity for PG&E to define and deploy a DERMS and supporting technology to uncover barriers and specify requirements to prepare for the increasing challenges and opportunities of DERs at scale. The DERMS Demo was a ground-breaking field demonstration of optimal control of a portfolio of 3rd party aggregated behind-the-meter (BTM) solar and energy storage and utility front-of-the-meter (FTM) energy storage to provide distribution capacity and voltage support services while also allowing for participation of these same DERs in the CAISO wholesale market.

CPUC Proceedings Supported:

- The findings from the project have been used to support changes to telemetry requirements for DER interconnections under Rule 21 (R.17-07-007), and informed PG&E's participation in Rule 21 Working Groups 3 and 4, and the Smart Inverter Working Group.
- R.11-09-011, Rule 21, Smart Inverter
- R.14-10-003, Integrated Distributed Energy Resources

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Market Influence: Through collaboration with the participating vendors, other PG&E demonstrations, and industry leaders to successfully demonstrate the potential of DERMS technology and achieve key learnings, the DERMS demonstration progressed the state of the industry.

Transitioned to Production or GRC Capital Requested: This project informed numerous foundational requirements around DER monitoring and communication within PG&E's 2020 General Rate Case (GRC), CH 19: Integrated Grid Platform Program and Grid Modernization Plan, specifically for Advanced DMA Platform and SCADA Replacement and Distribution GIS Asset Data Improvement investments.

Benefits:

- A. **Increase Safety:** Better visibility into DERs on the grid will give the utility more confidence that any switching operation on circuits with DERs accounts properly for the contributions of DERs, better preserving safety in situations where the grid is abnormally switched.
- B. **Improve Reliability:** While significant problems experienced by PG&E because of DERs are relatively infrequent today (e.g. masked load, capacity and voltage violations, reverse power flow), DER penetration is expected to increase in the future and DERMS technology could address the associated increase in issues related to the planning and operation of an increasingly complex distribution grid.
- C. **Reduce Costs:** DERMS technology may allow PG&E to avoid costly upgrades and plan the grid more efficiently. DERMS technology may also enable DERs to be more effectively used for wholesale market participation, unlocking additional value streams for customers and optimizations for front of the meter resources.
- D. **Complementary Benefits:** The development and deployment of a DERMS platform will enable the continued integration of renewables into the grid.

EPIC 2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)

This project field-demonstrated commercial Smart Inverters (SIs) on a high photovoltaic (PV)-penetration distribution feeder, evaluated a vendor-agnostic SI aggregation platform, and lab-tested multiple SI models. The project established that there is significant potential for cost-effective local voltage support from SIs to help mitigate local secondary voltage challenges caused by high PV penetration. The learnings from this project have directly contributed to an enhanced understanding of the potential of Smart Inverters, and are valuable for distribution grid operations, electric generation interconnection, distribution planning, and customer programs.

CPUC Proceedings Supported:

- The findings from the project have been actively used to support various regulatory forums and policies including the Rule 21 proceeding (R.17-07-007), Smart Inverter Working Group, and Distribution Resources Plan (DRP) proceeding (R.14-08-013).
- R.11-09-011, Rule 21, Smart Inverter
- R.14-10-003, Integrated Distributed Energy Resources

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Standards Influence: The findings from the project have been actively used to inform and Institute of Electrical and Electronics Engineers (IEEE) Smart Inverter standards.

Transitioned to Production or GRC Capital Requested: Provided insights and lessons about how to improve operations for the 2020 GRC, Chapter 19: Grid Modernization, specifically for Advanced DMA Platform and SCADA Replacement investments on distribution planning, interconnection enhancements, ADMS requirements, customer program(s) related to smart inverters, as well as policies and contractual agreements for customers to allow PG&E to use/control their smart inverters in the service of power quality.

Benefits:

- A. **Improve Reliability:** In its current form, today's grid—especially its distribution system—was neither designed nor equipped to accommodate such a high penetration of DER while sustaining high levels of electric quality and reliability. This project demonstrated SI capabilities to improve grid reliability by mitigating the impact of renewable resources on secondary and primary system voltage.
- B. **Reduce Costs:** Conventional mitigation measures (transformer upgrades, reconductoring, additional voltage regulation equipment, etc.) provide a possible path towards accommodating more distribution-connected DER in PG&E's service territory. CPUC Electric Rule 21 mandating the use of SIs with autonomous functions provides new, alternative solutions that may perform equally well with potential for improved ratepayer benefits. Specific 2.03A activities targeting cost reductions included 1) the evaluation of SI ability to help mitigate voltage problems resulting from high PV penetration on a distribution feeder and 2) the modeling study, which performed an economic analysis of SI capability vs. traditional grid upgrades across multiple PG&E distribution feeders and evaluated the potential to update PG&E standards for performing voltage rise studies when new BTM DERs are interconnected.
- C. **Complementary Benefits:** SIs can help to better integrate renewables, and, therefore, advance California energy policy to increase the amounts of renewable and distributed generation on the grid. By assessing SIs' ability to address DER-caused voltage issues through both the field demonstration and modeling, this project has shed light on SIs' potential to increase hosting capacity, potentially allowing for faster and more affordable interconnection of additional DERs onto PG&E's distribution system. Additionally, lab testing activities evaluated SI responses to extreme grid conditions, which may result in updates to SI standards.

EPIC 2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home

This project assessed the technical feasibility and potential benefits to individual customers and to ratepayers of vehicle to home (V2H) technology which can be utilized for resiliency and reliability. V2H is technically capable of islanding and supporting household load in outage and demand response events and customers reported high initial interest. However, the technology is not yet commercially available and vehicle warranties must be modified to allow for discharge, the cost to customers exceed their perceived benefits, and the net benefits to the utility and ratepayers are likely not sufficient to surmount the low cost-effectiveness for customers. The V2H market is nascent and requires further investigation ahead of PG&E commercialization activities.

CPUC Proceedings Supported:

- R.18-12-006, Development of Rates and Infrastructure for Vehicle Electrification (DRIVE)

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- R.13-11-007, Alternative-Fueled Vehicles Programs
- R.11-09-011, Rule 21, Smart Inverter

Market Influence: This project identified a set of key issues that will need to be addressed before V2H solutions can be commercialized.

Benefits:

- Increase Safety:** The project contributes to this principle by exploring and documenting the interconnection requirements for V2H technology ahead of broader commercialization. Currently, bi-directional power flow-capable EVs are not commercially available in the United States. For V2H technology to become a mass market product, the automotive manufacturers will need to build EVs with these capabilities. Documenting these requirements can inform all market actors' understanding of safety considerations while pursuing commercialization of the technology.
- Improve Reliability:** The project contributes to this principle by demonstrating technical feasibility at a proof-of-concept level that methods could be available to load serving entities for leveraging EVs to support DR activities during peak load and outage conditions. If the technology becomes commercially available, this capability could be useful to consider among other available approaches to support greater reliability across PG&E's system.
- Reduce Costs:** The project contributes to this principle by demonstrating the technical feasibility of V2H and validating the costs and benefits of the V2H technology at a directional, site-specific level to vet the potential commercial prospects of the technology before dedicating ratepayer funds to support commercialization. As this project helped to identify that V2H technology is not yet commercially viable, PG&E estimates this project helped to avoid what could have been up to a \$5.8M incentive program to spur V2H adoption.
- Complementary Benefits:** V2H could maximize a customer's existing renewable generation (PV) by paring it with EV and potentially SS. These non-fossil fuel-based power generation technologies can facilitate reducing GHG emissions by offsetting any fossil fuel-based generation on PG&E's system.

EPIC 2.04 - DG Monitoring & Voltage Tracking

This project demonstrated an algorithmic process to analyze new data sources (including SmartMeter™ devices and databases of solar irradiance) to predict the likelihood that a Rule 2 voltage violation was caused by distributed solar generation. Solar energy is by nature intermittent, and ebbs and surges of generation can change the voltage for neighboring, downstream customers. As solar adoption continues to grow, there is an increased likelihood of such voltage violations. This functionality, if integrated into a larger grid analytics platform, might improve decision making for Power Quality Engineers responding to customer issues, and Distribution Planners as they work to support safe and reliable solar installation across PG&E's service territory.

CPUC Proceedings Supported:

- R.14-08-013, Distribution Resources Plans

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Benefits:

- A. **Improve Reliability:** The results of this project can enable power quality, planning and operating engineers to better understand the likelihood that a voltage violation is caused by DG. For Power Quality, this potentially means faster response to customers. For Operating Engineers, this may save money by reducing the number of trouble man trips. For Planning Engineers, this may help make better DG siting decisions in the future.
- B. **Reduce Costs:** The ability to identify the likelihood and location of voltage problems associated with PV installations has the potential to reduce the time and costs of investigating and resolving violations, because trips to the field to investigate the problem gather data and implement the final resolution are reduced. The predictive analysis may also have the potential to enable PG&E to anticipate and avoid future voltage violations related to DG.
- C. **Complementary Benefits:** Providing the ability identify the likelihood of whether PV installations will create voltage problems could identify areas capable of supporting additional PV installations. This supports PG&E's shifting energy procurement requirements towards renewable generation sources and reductions in GHG emissions.

EPIC 2.05 - Inertia Response Emulation for DG Impact Improvement

This project explored the capabilities of inverter-based energy resources to provide a set of functions related to system inertia which support the electric system. The project demonstrated via transmission system modeling and Power-Hardware-In-Loop testing that advanced inverter control methods can provide active power support that improves the system's frequency response in the face of reduced conventional inertia from synchronous machine generators. Inverter control methods were explored including inertia-like response (derivative control) and grid-forming (voltage source) modes for respective benefits in bulk system and isolated distribution system use cases.

CPUC Proceedings Supported:

- R.11-09-011, Rule 21, Smart Inverter
- R.17-07-007, Streamlining Interconnection of Distributed Energy Resources and Improvements to Rule 21

Transitioned to Production or GRC Capital Requested: Provided insights and lessons about how to improve operations for 2020 GRC, Chapter 19: Grid Modernization, specifically for Electric Generation Interconnection investments. It will potentially revise PG&E's interconnection standards for storage, PV, or other inverter-based generation, enhancing the definition of how to safely and reliability integrate these technologies onto the system.

Benefits:

- A. **Improve Reliability:** The project found that new approaches will be needed in the future for managing the moment to moment balance of load and generation across the system, as measured in the system frequency. This project explored, demonstrated, and advanced the use of inverters to use new control methods to maintain system frequency as the system relies increasingly on renewable energy. The deployment of this synthetic inertia functions could be a key component to the suite of solutions for enhancing reliability under the range of disturbances the

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system will face. The project's findings also show that advanced inverter controls have high potential for managing loads and responding to disturbances in both transmission connected and islanded distribution scenarios. Further advancement of using grid forming inverter modes showed great promise for resiliency applications as well, demonstrating successful transitions from grid-sourced to battery-sourced states on a distribution circuit.

- B. **Reduce Costs:** The project explored solutions to keep the power system operating safely and reliably in a future with high renewables. They aim to find optimal technical approaches that would reduce the overall cost to operate and maintain the power system at a high level of performance. As such, the project takes a long view of affordability, advancing solutions towards more optimal cost and performance tradeoffs in the future. The project also explored solutions that would reduce total system cost for distribution reliability and resilience services. More advanced BESS inverter controllers could reduce the total costs for monitoring and control of these applications, thus improving the affordability and service benefits for utility customers.
- C. **Complementary Benefits:** The technology demonstrated in this project ultimately addresses impending problems that could hamper the deployment of renewable energy. By preempting these problems, the solutions explored here support the continual reduction of the GHG intensity of the energy industry through greater use of renewable resources.

EPIC 2.07 - Real-Time Loading Data for Distribution Operations and Planning

This project developed analytical methods for generating near real-time load forecast information. The project successfully built and demonstrated a platform to ingest and process SmartMeter™, Supervisory Control and Data Acquisition (SCADA), photovoltaic system (PV) generation, Geographic Information System (GIS) and weather data for two of the eight Areas of Responsibility (AOR) within PG&E's service territory.

Transitioned to Production or GRC Capital Requested: Provided insights and lessons about how to improve operations for 2020 GRC, Chapter 19: Grid Modernization, specifically for Advanced DMA Platform and SCADA Replacement investments.

Benefits:

- A. **Increase Safety:** Having look ahead visibility into dynamic grid load conditions will allow operators to better plan for maintenance and enhance operational decision-making awareness.
- B. **Improve Reliability:** Providing forecasted load visibility to distribution engineers and operators to allow them to manage distribution switching for both planned and unplanned events more quickly and with less switching steps.
- C. **Reduce Costs:** Having accurate predictive load forecasts may reduce the number of switching steps required to perform maintenance and restoration and therefore reduce operational costs.

EPIC 2.10 - Emergency Preparedness Modeling

The project developed and demonstrated a decision support system that successfully recommends optimal restoration and resource allocation strategies for PG&E electric assets after a disruptive event occurs.

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Benefits:

- A. **Increase Safety:** This application will allow resources to more rapidly respond to public safety incidents. Deploying the appropriate amount of resources to an event will allow safety personnel to rapidly address hazards like a downed wire or leaning pole.
- B. **Improve Reliability:**
 - a. Reduced restoration times leading to a more reliable electrical service: Accurate resource allocation recommendations in advance of an event will ensure that logistics will provide the right amount of support, while mutual aid or contractors can be activated and transported to the optimal locations. These decisions require lead time, so timely analysis or forecasts will eliminate any delays associated with acquisition or decisions that need to be made due to a faulty analysis.
 - b. Enhance reliability using real-time information: The Emergency Operations Center (EOC) would have the ability to explore restoration strategies using real-time information to enhance reliability of the electric and gas systems. This project could enable PG&E to better quantify, in real-time, the impacts of events and the impacts of different restoration activities taken on power outages and costs.
 - c. This project has the potential to achieve reliability benefits by increasing PG&E's ability to model natural hazards and outage restorations. The tool can be agnostic to type of emergency (earthquake, flood, fire, tsunami, major storm, etc.). Benefits are multiplied because the tool has the potential to handle any type of major catastrophic event, and scale accordingly to the importance of the event.
- C. **Reduce Costs:** The optimization of restoration plan development can reduce cost by recommending the most efficient allocation of resources.

EPIC 2.14 - Automatically Map Phasing Information

This project successfully developed and demonstrated automated analytical methods for determining meter phasing and meter-to-transformer connectivity using SmartMeter™, Supervisory Control and Data Acquisition (SCADA) and Geographic Information System (GIS) data. The distribution network model is central to multiple existing control systems, system analyses, and work processes. As the load characteristics of the distribution network evolve, such as with the growth of Distributed Energy Resources (DER), it is becoming more important to have accurate and up-to-date network model information to be able to actively manage the distribution system. Automated approaches for obtaining this information can offer a more efficient alternative to the conventional boots-on-the-ground approach.

CPUC Proceedings Supported:

- R.14-08-013, Distribution Resources Plans

Transitioned to Production or GRC Capital Requested: The full-scale deployment of this project's solutions was included in PG&E's 2020 GRC, CH 19: Integrated Grid Platform Program and Grid Modernization Plan.

Benefits:

- A. **Increase Safety:** This project contributes to this principle by proving that granular visibility into distribution network phasing over time using SmartMeter™ voltage data is possible. When combined with other tools and techniques into a targeted operational use case, this capability could enable detection of broken wires with greater accuracy and support the restoration of power faster when an outage occurs.

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- B. **Improve Reliability:** This project demonstrated that automated phase asset mapping through algorithmic analysis can be achieved at a satisfactory accuracy level. This capability is critical to improving engineering practices for phase balancing that achieves greater reliability across PG&E's system. Improved phase balancing on the distribution network, and the resultant reliability improvements across the network, support the requirements for unbalanced power flow and state estimation in the proposed ADMS, and DERMS platforms.
- C. **Reduce Costs:** These automated solutions, if deployed across PG&E's full service territory, would potentially provide over \$20M in avoided cost savings and reduced customer bills compared to a PG&E-wide conventional "boots on the ground" phase identification effort.
- D. **Complementary Benefits:** Better Phase ID can help accommodate the interconnection of renewable DER. These non-fossil fuel-based power generation technologies can facilitate GHG emissions reduction by offsetting fossil fuel-based generation on PG&E's system.

EPIC 2.15 - Synchrophasor Applications for Generator Dynamic Model Validation

This project installed Phasor Measurement Units (PMUs) on the three generators at PG&E's Colusa Generation Station, developed station generator models using commercial software, and used actual disturbance data collected online (in lieu of offline test data) to test new synchrophasor applications for generator model validation. The integration of PMUs on generators for dynamic model validation is a new technology and the project did not result in a tool that is production ready. As applications evolve, installation of PMUs at generating stations could potentially allow utilities to enhance their generator model validation processes.

Transitioned to Production or GRC Capital Requested: Provided insights and lessons about how to improve operations for 2020 GRC, Chapter 4: Hydro Operations Costs.

Benefits:

- A. **Improve Reliability:** The project demonstrated the use of synchrophasors and associated software tools to perform parameter estimation for generator dynamic models remotely using collected disturbance data. Current processes require testing at the power plant. More accurate generator models would result in more accurate grid reliability studies. The tool and methodology tested did not conclusively demonstrate that it could be replace current test methods based on the reasons covered in the final report.
- B. **Reduce Costs:** The collection and use of synchrophasor data, to perform NERC-mandated generator dynamic model calibration, potentially reduces the need to perform tests at the power plants. This could reduce costs and is an efficient use of ratepayer monies. As noted in the final report, the cost savings was not proven sufficient to justify the cost of installing generator PMUs.

EPIC 2.19 - Enable Distributed Demand-Side Strategies & Technologies

This project evaluated the performance and efficacy of using customer-sited behind-the-meter storage for grid and reliability services. The project utilized both residential and commercial assets via two vendor platforms. BTM Energy storage is technically feasible for the use cases evaluated, but before a full program is pursued there are opportunities for improvement.

CPUC Proceedings Supported:

- R.14-10-003, Integrated Distributed Energy Resources

Preliminary Benefits Table

Transitioned to Production or GRC Capital Requested: Provided insights and lessons about how to improve operations for 2020 GRC, Chapter 19: Grid Modernization, specifically for Advanced DMA Platform and SCADA Replacement investments.

Benefits:

- A. **Improve Reliability:** This project explored the use of customer-sited behind-the-meter storage to respond to instructions to charge during times of maximum solar output and discharge during the later afternoon net load ramp when solar output is declining, an application of the technology which could contribute to grid reliability. In addition, the project investigated the dual-use of customer-owned storage to provide back-up power for individual customers.
- B. **Reduce Costs:** This project explored the use of customer-sited BTM energy storage to provide commercial customers with opportunities to lower their cost of energy via peak load shaving to avoid demand charges, while also executing directions to charge during times of maximum solar output and discharge during the later afternoon net load ramp when solar output is declining.
- C. **Complementary Benefits:** In addition to testing the ability of customer-sited storage systems to absorb system solar power, this project also explored the use of residential storage co-located with solar PV systems to charge the batteries exclusively using solar power. Both applications of customer-sited energy storage can help better integrate renewables.

EPIC 2.21 - Home Area Network (HAN) for Commercial Customers

This project demonstrated the viability and usefulness of access to real-time energy use data for commercial customers. This technology demonstration accomplished three set objectives: 1) verified Zigbee enabled SmartMeters™ for Large Commercial and Industrial customers have the same ability as residential meters to provide real-time usage information via the HAN radio; 2) Identified and assessed LC&I customers' needs and meaningful use cases (i.e. opportunities) for real-time data; 3) Identified the barriers to adoption, integration, and utilization of HAN devices at scale for LC&I customers.

Benefits:

- A. **Reduce Costs:** The project aimed to provide affordability benefits to customers by providing real-time AMI data to customer for Demand-Side Management (DSM). The technology presented in this project has the potential to offer an affordable option to maximize DSM if and when site installation requirements are met. Benefits will vary by customer. Some sites required modification or adaption to implement real-time data feeds, while other sites required a greater investment in time and resources to integrate the data into their EMS. The greatest benefits are likely to accrue where multiple locations are under a single EMS.
- B. **Complementary Benefits:** This project has shown real-time data directly enabled intervention actions related to quick PV system failure detection and recovery, and modification to DR strategy during DR event period. These interventions can lead to reduction in GHG gas emissions through lower energy usage and increase up-time of renewable energy resources.

EPIC 2.22 - Demand Reduction through Targeted Data Analytics

This project developed a tool that leverages customer level data along with grid information and forecasts to create a robust optimization engine for identification of the lowest cost solution capable of deferring or mitigating the need for an asset upgrade due

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to capacity limitations. The tool considers both traditional wires solutions and DER portfolios and allows Distribution Planners to complete advanced scenario analysis.

CPUC Proceedings Supported:

- R.14-08-013, Distribution Resources Plans
- R.14-10-003, Integrated Distributed Energy Resources

Transitioned to Production or GRC Capital Requested: This project provided insights and lessons about how to improve operations for 2020 GRC, Chapter 19: Grid Modernization, specifically for Distribution Engineering Planning Tools investments and will be scaled up to support PG&E's advancing distribution planning processes through optimized location-specific targeting to leverage cost-effective, non-wires alternatives based on grid needs. The tool developed through this EPIC project has already been applied to the annual Distribution Deferral Opportunity Report (DDOR) and is expected to significantly improve the efficiency and effectiveness of PG&E's distribution planning process going forward.

Benefits:

- Improve Reliability:** The tool demonstrated in this project allows us to reduce the need to make equipment replacements and therefore reduce planned and unplanned outages.
- Reduce Costs:** The tool developed in this project has the potential to significantly improve the efficiency and effectiveness of PG&E's distribution planning process going forward. The total annual benefit of the application of the optimization tool associated with 1) the identification and deferral of distribution capacity upgrades and 2) improvements in process efficiency is estimated to be \$3.5M.
- Complementary Benefits:** The DER portfolios recommended by the tool demonstrated in this project reduce load requirements for the utility and therefore associated GHG emissions.

EPIC 2.23 - Integrate Demand Side Approaches Into Utility Planning

This project successfully developed and demonstrated the integration of a broader range of customer-side technologies and Distributed Energy Resources (DER) approaches into the utility planning process. The project served as a necessary and enabling precursor to the fulfillment of Assembly Bill (AB) 327/ Section 769, which requires transparent, consistent and more accurate methods to cost-effectively integrate DERs into the distribution planning process. This project delivered new load shape profiles, enhanced load forecasting tool and overall analytical process that allows PG&E to more accurately and consistently integrate DER impact to the distribution system load profile. With these enhancements, PG&E can evaluate if DER growth could defer or even in some instances eliminate the need for future network upgrades. Leveraging any of the SmartMeter™ data, PG&E created more accurate and granular load shapes that allowed distribution planners to more precisely capture DER impact on the load growth forecast.

CPUC Proceedings Supported:

- R.14-08-013, Distribution Resources Plans

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- R.14-10-003, Integrated Distributed Energy Resources

Transitioned to Production or GRC Capital Requested: This project provided insights and lessons about how to improve operations for 2020 GRC, Chapter 19: Grid Modernization, specifically for Distribution Engineering Planning Tools investments to ensure that DER forecasts are incorporated in PG&E's planning process. The improved load forecasting capabilities developed in this project have been transitioned to operational use in support of the distribution planning process.

Benefits:

- Increase Safety:** By hierarchically aggregating load shapes, PG&E engineers can leverage load forecasts to project the timeframe when power flow could reverse at certain distribution system components (e.g. voltage regulators, protective devices) that are not presently designed to operate under such conditions. The reverse power flow could create a safety concern, as equipment may be more likely to fail. With prior knowledge of such a condition possibly existing, PG&E planners could potentially address the problem and eliminate the safety concern.
- Improve Reliability:** The project leveraged SmartMeter™ data to generate more accurate load shapes and DER adjustment forecasts at the system and granular (customer) level. With more accurate representation of load and DER adoption, distribution engineers can better model current and future grid conditions. Consequently, the system simulation results will more accurately represent the direction and magnitude of power flows. Recommended infrastructure modifications, and equipment specifications and settings can therefore better match the actual conditions, improving the reliability of the system. This enhancement supports the ability to decrease overloads, of which wear on the system components inherently increases risk of outages.
- Reduce Costs:** The ability to include DER adjustment forecast in an integrated least-cost planning framework will potentially result in lower system costs, by avoiding system upgrades where load growth will be offset with DER adoption. By having the ability to analyze the DER profile impact on the overall load shape, PG&E will be able to potentially target certain DER programs that have the shape and magnitude appropriate to defer or eliminate network upgrades.
- Complementary Benefits:** This project can potentially reduce GHGs by helping to identify additional opportunities for distribution connected renewable generation.

EPIC 2.26 - Customer & Distribution Automation Open Architecture Devices

PG&E's AMI Network is one of the largest private Internet Protocol Version 6 (IPv6) networks in the United States, with more than 5 million AMI devices connected across its electric network. This project investigated the use of the AMI network for purposes beyond the collection of electricity usage data. The project successfully demonstrated the ability of a Client-Server architecture consisting of an IoT router to establish communication, monitoring, command, and control of various third-party and utility end devices such as smart inverters, sensors, SCADA devices, RFID readers and distributed generation controls over the AMI network using the IEEE 2030.5 protocol.

Transitioned to Production or GRC Capital Requested: The AMI-based RFID tracking capability for meter inventory management and asset identification is planned to be deployed through the GRC.

Preliminary Benefits Table

Benefits:

- A. **Improve Reliability:** This project demonstrated the potential to use the AMI (mesh) network for communicating with SCADA and other electric distribution energy devices. A mesh network is more reliable than a non-mesh network because when one node is inoperable, other nodes can still communicate with each other directly or through intermediate nodes.
- B. **Reduce Costs:** The AMI-based RFID tracking capability for meter inventory management and asset identification showed the potential to reduce inventory costs.

EPIC 2.27 - Next Generation Integrated Smart Grid Network Management

This project demonstrated a new AMI Network management system (a "manager of managers") to holistically and more effectively monitor, control, and evolve the existing AMI network and infrastructure. Currently, PG&E leverages multiple AMI networks with separate operational systems. Leveraging disparate systems limits the ability to optimally manage workflow and prioritize and schedule data processes (for instance, ensuring remote connect/disconnect is prioritized over tenant application queries).

Transitioned to Production or GRC Capital Requested: Provided insights and lessons about how to improve operations for 2020 GRC, Chapter 8: Information Technology.

Benefits:

- A. **Increase Safety:** The automation of processes demonstrated through this project to identify and notify technicians of potentially hazardous conditions related to meter temperature, incorrect meter-wiring, or energy diversion could allow for these conditions to be identified sooner and resolved faster than is possible through current manual processes.
- B. **Improve Reliability:** The aggregation of data across PG&E's three AMI networks into a single management platform contributes to overall SmartMeter network reliability by providing, on a real-time basis, a high-level view of identified problems and then allowing for a quick drill down for evaluation and when appropriate, automatically generating and tracking follow-up work orders. Reliability of the SmartMeter network contributes to overall grid reliability by providing visibility to problems and enablement of troubleshooting in real time.
- C. **Reduce Costs:** The more efficient diagnosis of problems through process automation demonstrated through this project has the potential to reduce labor costs. This project demonstrated the ability to quickly narrow the problem area to provide improved information on when and what type of personnel to dispatch to resolve an issue. In addition, by quickly resolving issues such as high temperature sockets, equipment damage and replacement can be avoided.

EPIC 2.28 - Smart Grid Communications Path Monitoring

This project sought to 1) Conduct an initial noise assessment to establish a baseline of radio frequency interference (RFI) in the AMI Networks, 2) Analyze a continuous flow of data to identify potential locations and sources of RFI, and 3) Develop an end-to-end process/tool from monitoring to mitigation of interference. PG&E identified through a sample of radio frequency (RF) data that there are potential channel congestion issues that can lead to RFI conflicts in the AMI networks, however no specific RF tools existed to identify RFI signal(s) in PG&E's local Neighborhood Area Network (NAN). Given the RF dataset availability and access limitations,

Preliminary Benefits Table

there was no feasible path to demonstrate a successful algorithm-based application for proactive automated interference detection. The preliminary work completed on this project could be leveraged in the development and/or use of future tools and in formulation of strategies around broader prevention of PG&E's network RFI.

Benefits:

- A. **Reduce Costs:** Given the significant data access limitations encountered early in this project, there was no feasible path forward for the project team to demonstrate a successful algorithm-based application for proactive automated interference detection. Although a small sample of channel loading data was obtained for a small test area in San Francisco, the lack of continuous data points and resolution of this information restricted algorithm development and the ability to execute a complete end-to-end RFI solution. As such, PG&E made an early decision to discontinue the project and avoid any unnecessary further expenditures towards the project.

EPIC 2.29 - Mobile Meter Applications

This project designed, built, and tested the Next Generation Meter (NGM). This electricity meter was demonstrated to be the first revenue grade, high resolution real time power meter that fully met national standards for metering including ANSI C12.1 and ANSI C12.20 (accuracy), ANSI C12.19 (meter data table format) and C12.22 (cellular communication protocol format). The NGM was developed with a compact, modular design that takes advantage of a host of new technologies including faster microprocessors, expanded memory, and multiple communications pathways—all contained in a hardware package that is the size of a credit card. The NGM has the ability to: 1) Be installed in a wider range of locations beyond traditional customer premises, 2) Reduce meter maintenance and replacements costs, 3) Improve the grid operator's situational awareness during outages, and 4) Provide additional services and applications as grid-edge technology evolves.

CPUC Proceedings Supported: This project is the predecessor to EPIC 3.27, which will develop a revenue-grade EV submeter, in support of several proceedings:

- Distribution Resources Plan (R.14-08-013)
- Alternative-Fueled Vehicle (R.09-08-009)
- R.13-11-007, Alternative-Fueled Vehicles Programs
- Vehicle Electrification Rates and Infrastructure (R.18-12-006)
- CPUC Draft Transportation Electrification Framework

Benefits:

- A. **Increase Safety:** The design of NGM separates high and low voltage metering components of a SmartMeter™. This separation reduces the exposure of field technicians to high voltages during maintenance and repair of meters.
- B. **Reduce Costs:** The design of the NGM modularizes meter components by separating high and low voltage components, which can significantly reduce both maintenance and operating costs. This provides the flexibility to replace only failed components, as opposed to the entire meter when one component fails.

Preliminary Benefits Table

- C. **Complementary Benefits:** The NGM will have the capability to consolidate metering of EV's energy usage/charges at public locations/stations, or at home. This will enhance EV ownership and encourage the use of low-emission vehicles.

EPIC 2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors

This project demonstrated and compared the performance of multiple sensor-based technologies for predicting deterioration and imminent failure of distribution assets. The demonstration proved that there is strong predictive performance and operational benefits in deploying these predictive capabilities at a broader scale in the distribution system.

CPUC Proceedings Supported:

- R.18-10-007, requiring the IOUs to develop Wildfire Mitigation Plans

Market Influence: Through course of the demonstration, the project team gave the vendors of the technologies being demonstrated extensive feedback that is being incorporated into improved versions of their sensor solutions.

Transitioned to Production or GRC Capital Requested: The sensors from this project are being transitioned to production at the project's limited demonstration sites, and the sensors are planned to be rolled out to additional distribution circuits in high fire threat districts using GRC funds.

Benefits:

- A. **Increase Safety:** RF network monitoring offers to reduce the rate of occurrence of many classes of network faults that are known wildfire risks in California and globally. The technology predicts powerline fire risks ranging from vegetation encroachment to conductor (and conductor clamp) failure. Its predictive identification of risks allows them to be addressed proactively before they materialize. The project demonstrated that the ensemble sensor technology approach provides backup and needed validation between sensor technologies resulting in a resilient and robust vision into the performance and risks of the distribution system.
- B. **Improve Reliability:** The RF network monitoring system offers to reduce the number of network faults caused by deteriorated, damaged and compromised electricity network assets. The risks predictively identified in the trial were all known to be common causes of faults on PG&E's electricity distribution and transmission networks - faults that can and do regularly lead to interruptions to customer supply. Early warning of these risks can prevent the associated supply interruptions, thereby increasing supply reliability.
- C. **Reduce Costs:** Cost savings will result from the difference between repair to damaged equipment under normal schedule operating conditions instead of emergency conditions. If hazardous asset conditions are allowed develop to faults and asset failure, there is additional damage to asset infrastructure through the wear and tear of faults, as well as collateral damage to equipment near the fault. Additional operational performance savings, such as reduction in system losses, would be achieved through the validation of correct operations of field equipment. Deployment of the sensors demonstrated through this project on 75 additional feeders could potentially result in around \$12,000,000 in annual savings.

Preliminary Benefits Table

EPIC 2.36 - Dynamic Rate Design Tool

This project designed and developed a tool that leverages advanced technologies to allow for the rapid evaluation of rate designs, new billing determinants, and enables a more robust, powerful and rapid bill impact analysis process than the current models allow.

Benefits:

- A. **Reduce Costs:** Using the rate design tool would enable employees to run analyses faster. The tool would enable employees to be more efficient and focus more on innovative rate design and evaluation.
- B. **Complementary Benefits:** Using the rate design tool developed through this project would lead to a reduction in errors in the rate design and evaluation processes by eliminating manual transfer of inputs and outputs.

EPIC 3.03 - Advanced DERMS and ADMS

This project is developing a DERMS head-end system and associated interfaces to provide a low-cost solution for DER telemetry and control, to manage both on-grid DERs and remote grids. The development of a low-cost telemetry solution through this project is a commitment made through the Smart Inverter Working Group in the Interconnection Rulemaking (R.17-07-007).

CPUC Proceedings Supported:

- Distribution Resources Plan (R.14-08-013)
- Integrated Distributed Energy Resources (R.14-10-003)
- Integrated Resource Plan (R.16-02-007)
- Rule 21, Smart Inverter (R.11-09-011)
- Streamlining Interconnection of DERs and Improvements to Rule 21 (R.17-07-007)
- IOU Wildfire Mitigation Plans (R.18-10-007)
- Microgrids Pursuant to Senate Bill 1339 and Resiliency Strategies (R.19-09-009)

Market Influence: EPIC 3.03 will be one of the first projects to develop and deploy a low-cost telemetry solution compliant with Rule 21 requirements. As part of the project, PG&E issued an RFP and selected three vendors to deliver three gateways to meet these and additional PG&E requirements. PG&E will work with these vendors to publish recommended industry standards for a low-cost telemetry solution. In addition, PG&E is developing and deploying one of the first 3rd-party CSIP certified head end systems.

Standards Influence: As PG&E continues to gain experience and lessons learned through the development of the DERMS EPIC 3.03 project, PG&E will work to address any gaps found in CSIP, IEEE 2030.5, Sunspec, and relevant cybersecurity standards via collaboration with the Smart Inverter Working Group, other CA IOUs, industry, and Standards bodies.

Transitioned to Production or GRC Capital Requested: Per the commitment made through the Smart Inverter Working Group, the low-cost telemetry developed and demonstrated through this EPIC project will be transitioned into production in 2021.

Preliminary Benefits Table

Benefits:

- A. **Increase Safety:** The DERMS will enable distribution operators to have enhanced situational awareness and control capabilities for DERs that are supporting the grid needs as part of Wildfire Mitigation Plan resilience initiatives.
- B. **Improve Reliability:** The DERMS will enable the ability to dispatch registration data requests to verify compliance of SIs with Rule 21 curve settings and monitor SI-based DERs to maintain safe and reliable grid operations.
- C. **Reduce Costs:** The DERMS aims to reduce the cost of telemetry to DERs interconnecting onto PG&E distribution grid. The current costs are at a minimum \$150k per DER for telemetry costs back to the utility through either the installation of a Mini-RTU unit or a Recloser. This project aims to lower that to \$20k per DER. Since it is expected there will be somewhere between 50-100 DERs requiring telemetry per year, this equates to around a \$10M savings per year for these interconnections.
- D. **Complementary Benefits:** The DERMS will enable compliance with Rule 21 Order Instituting Rulemaking (OIR) Issue 9. As part of this OIR CPUC is exploring the option to allow interconnection of DERs with constrained generation agreements so that generators can avoid distribution upgrade and operate at a higher value when not constrained. This project will develop and demonstrate the enhanced systems and tools that will enable compliance to emerging and future requirements.

EPIC 3.11 - Location Targeted DERs

Through this project, PG&E is working with partners, including the CEC, to configure the Arcata-Eureka airport's local microgrid controller to integrate with PG&E's distribution network and enable Distribution Control Center visibility and control of the microgrid. The project will develop scalable and replicable approaches to planning, designing, deploying and operating multi-customer microgrids that will be essential to enabling the broader implementation of multi-customer microgrids going forward.

CPUC Proceedings Supported:

- Distribution Resources Plan (R.14-08-013)
- Distribution Resource Adequacy (R.11-10-023)
- Integrated Distributed Energy Resources (R.14-10-003)
- Integrated Resource Plan (R.16-02-007)
- IOU Wildfire Mitigation Plans (R.18-10-007)
- Microgrids Pursuant to Senate Bill 1339 and Resiliency Strategies (R.19-09-009)
- Energy Storage Procurement Program (R.15-03-011)

Market Influence: The Redwood Coast Airport Microgrid will serve as a model for the deployment of other microgrids in the state of California and beyond, helping to establish hardware, software, communications, and tariffs requirements.

Standards Influence: This project will pioneer industry standards for replicable processes for the provisioning of local multi-customer microgrid controllers, and for the communication and controls between those controllers and the larger grid.

Preliminary Benefits Table

Benefits:

- A. **Increase Safety:** Microgrids serve as a source of energy that enable grid operators carry out safety and maintenance operations with greater ease, and reduce the customer impacts during PSPS events
- B. **Improve Reliability:** Microgrids can reduce the impact of power outages on a customer's perspective on utility reliability. This technology can continue to energize regions of the service territory that undergo PSPS during times of high wildfire risk, enabling wider use of PSPS to drive down wildfire ignition across the service territory.
- C. **Complementary Benefits:** The addition of solar and battery energy storage systems in microgrids will reduce the use of diesel generators during power outages.

EPIC 3.15 - Proactive Wire Down

This project is demonstrating Rapid Earth Fault Current Limiter (REFCL) technology at a PG&E substation serving a high fire-risk area, to assess its effectiveness at automatic current reduction in wires-down events, with the goal of drastically reducing the likelihood of wires down events causing wildfires.

CPUC Proceedings Supported:

- IOU Wildfire Mitigation Plans (R.18-10-007)

Market Influence: PG&E is working with the vendors that provide REFCL technology components to configure their product offerings for deployment on United States power grids, whereas previously REFCL has only been deployed by utilities overseas.

Standards Influence: This demonstration will inform the deployment of other REFCL systems on California's electric grid, standardizing requirements for design, construction, and performance.

Transitioned to Production or GRC Capital Requested: Pending successful demonstration, broader deployment of the REFCL solution is planned for additional substations in high fire thread districts through the GRC.

Benefits:

- A. **Increase Safety:** This promising REFCL solution has the potential to reduce the number of ignitions from wires-down events on the 12kV distribution circuits in PG&E's High Fire Threat Districts by over 50%.
- B. **Improve Reliability:** REFCL could improve reliability over the operating practice of proactively de-energizing circuits during high fire risk events. This project could also improve reliability by riding through transient faults.
- C. **Reduce Costs:** Using REFCL to reduce the likelihood of ignition in turn reduces the likelihood of catastrophic wildfires and the associated financial impacts of those fires.

Preliminary Benefits Table

EPIC 3.20 - Maintenance Analytics

This project is leveraging Geographic Information System (GIS), weather, SmartMeter™, Supervisory Control and Data Acquisition (SCADA) and other data to develop and demonstrate analytical models that predict when maintenance will be needed for distribution assets.

CPUC Proceedings Supported:

- IOU Wildfire Mitigation Plans (R.18-10-007)

Market Influence: The overarching data science techniques are planned to be shared with the industry to enable broader market innovation around data-driven prediction of asset failure and maintenance needs.

Transitioned to Production or GRC Capital Requested: Upon successful demonstration the software tool will be transitioned to production and may require additional hardening and enhancements using GRC funds. The insights from this project may also help to inform broader GRC requests.

Benefits:

- Increase Safety:** Prediction of equipment requiring maintenance may potentially reduce public exposure to hazardous catastrophic equipment failure.
- Improve Reliability:** Predictive equipment maintenance may potentially reduce unscheduled outages caused by failed equipment.
- Reduce Costs:** Predicting that line equipment will require maintenance means that maintenance can be scheduled within normal operating workflow and avoid expensive unscheduled maintenance. Permitting targeted inspections as opposed to periodic inspections will better optimize field resources. Improved equipment operation will help optimize system performance.

EPIC 3.27 - Multi Purpose Meter

This project will leverage the Next Generation Meter (NGM) developed in EPIC 2.29 to develop a utility-grade electric vehicle and EV charging submeter prototype that can be easily plugged into readily available level 2 and emerging level 3 EV charge stations. PG&E, the other California IOUs and industry influencers will update the EV submetering standard for CPUC adoption.

CPUC Proceedings Supported:

- Distribution Resources Plan (R.14-08-013)
- Alternative-Fueled Vehicle (R.09-08-009)
- R.13-11-007, Alternative-Fueled Vehicles Programs
- Vehicle Electrification Rates and Infrastructure (R.18-12-006)
- CPUC Draft Transportation Electrification Framework

Preliminary Benefits Table

Standards Influence: The design changes made to the EV charge stations by integrating the NGM will be reflected in EV submetering standards.

Transitioned to Production or GRC Capital Requested: 20 EV submeters will be developed and demonstrated at sites within PG&E's service territory as part of the EPIC project. If the demonstration is successful additional funding in support of broader scale deployment will be requested through the GRC.

Benefits:

- A. **Increase Safety:** The separation of high and low voltage components enables the NGM core to be incorporated into EV chargers for easy and safe installation without exposure to high voltage hazards.
- B. **Improve Reliability:** This meter will allow for non-traditional meter installations to obtain granular data (Voltage, current, temperature, etc.) which enables monitoring capability and visibility.
- C. **Reduce Costs:** Reduced meter asset material and labor installation costs would demonstrate affordability and better use of rate-payer monies.
- D. **Complementary Benefits:** This meter will help the customers to reduce/avoid electrical panel installations which will enable more customer to access to EV rate. Ultimately, this project will also promote clean transportation and reduce greenhouse gas.

EPIC 3.32 - System Harmonics

This project is demonstrating the use of modern SmartMeters™ to detect, investigate and mitigate harmonic issues on the distribution system. Harmonics issues on the grid negatively impact customer equipment operation and can also damage utility assets.

CPUC Proceedings Supported:

- IOU Wildfire Mitigation Plans (R.18-10-007)

Market Influence: Currently, not all AMI meters have harmonics capability. If the project is proven successful, more meter vendors may consider adding harmonics capability to their product offerings to utilities.

Standards Influence: The project relies on the industry standard for harmonics (IEEE 519). The results of 3.32 which is using harmonics data from AMI meters may be shared with the IEEE 519 working group at IEEE annual conference and other power quality organizations such as CEATI.

Transitioned to Production or GRC Capital Requested: Through the EPIC project, modern SmartMeters™ capable of capturing harmonics data will be deployed to a limited number of sites in areas with high harmonics issues, to support the completion of the demonstration. If successful, broader deployment across PG&E's service territory will be conducted using GRC funds.

Preliminary Benefits Table

Benefits:

- A. **Improve Reliability:** The current process for identifying and responding to harmonics issues is reactive and manual. Having real time access to harmonics data will help shorten the investigation time and resolution of customer power quality issue which results in reduction of customer equipment downtime.
- B. **Reduce Costs:** Harmonics data from next generation metering technology will reduce labor hours and operational costs associated with power quality investigation due to harmonics issues. Successfully resolving harmonics issues for customers will also prevent customer loss of potential revenue due to equipment downtime.

EPIC 3.41 - Drone Enablement

This project will demonstrate the feasibility and value of advanced drone operations for two important PG&E use cases. The first use case will explore automated and Beyond Visual Line-of-Sight (BVLOS) drone operations to collect imagery needed for the routine inspection of complex, high-voltage transmission structures. The second use case will employ automated and BVLOS dispatch of drones from PG&E substations to investigate alerts generated by distribution system sensors, such as those being demonstrated by EPIC 2.34.

CPUC Proceedings Supported:

- IOU Wildfire Mitigation Plans (R.18-10-007)

Standards Influence: This project will involve coordination with the FAA on the development and approval of a Part 107 waiver application, to enable drone operations for PG&E's two use cases. This could help pave the way for other utilities subsequently requesting FAA approval for similar use cases.

Transitioned to Production or GRC Capital Requested: Each of the project's two use cases will be conducted at a limited geographic scale within PG&E's service territory. If successful, broader deployment to the transmission lines, substations and distribution circuits within PG&E's High Fire Threat Districts will be requested through the GRC.

Benefits:

- A. **Increase Safety:** PG&E currently flies drones manually within visual Line-of-Sight (LOS) to capture the extensive sets of images used to inspect these structures. Automating drone flights and extending BVLOS has the potential to offer a highly safe, repeatable, and efficient process that will significantly improve upon the manual approach employed today. As sensor-based alerting systems are deployed more broadly within High Fire Threat Districts (HFTD), dispatching drones as the first line of investigation for potential asset issues could provide a safer solution compared to the current approach of sending crews in trucks to investigate every qualified event.
- B. **Improve Reliability:** The automated dispatch of drones to investigate analytically-triggered alerts of potential asset issues could enable faster and improved verification of potential issues, and improved resolution of issues before assets fail and outages occur.
- C. **Reduce Costs:** Automating drone operations, extending drone operations beyond visual LOS, and sending drones to conduct preliminary investigations instead of crews in trucks or helicopters has the potential to result in significant reductions in operating costs. Imagery captured

Preliminary Benefits Table

by drones will contribute to a robust foundation of data, enabling continued advancements in machine learning applications such as automated image classification, which will reduce the need for manual image review.

EPIC 3.43 - Momentary Outage Information

This project is leveraging multiple sources of data, including but not limited to SmartMeter™, time of day, location and weather data, to proactively identify potential problems in the Electric Distribution system, specifically related to identifying locations with high incidences of momentary outages which may be caused by imminent failures of conductors, insulators, transformers and/or vegetation contact.

CPUC Proceedings Supported:

- IOU Wildfire Mitigation Plans (R.18-10-007)

Market Influence: The overarching data science techniques are planned to be shared with the industry to enable broader market innovation around data-driven prediction of asset failure and maintenance needs.

Transitioned to Production or GRC Capital Requested: Upon successful demonstration the capabilities developed in this project will be transitioned to production and may require additional enhancements and broader scale rollout using GRC funds. The insights from this project may also help to inform broader GRC requests.

Benefits:

- Increase Safety:** Prediction of equipment requiring maintenance may potentially reduce public and employee exposure to hazardous catastrophic equipment failure.
- Improve Reliability:** Predictive equipment maintenance may potentially reduce unscheduled outages caused by failed equipment.
- Reduce Costs:** Predicting that line equipment will require maintenance means that maintenance can be scheduled within normal operating workflow and avoid expensive unscheduled maintenance. Permitting targeted inspections as opposed to periodic inspections will better optimize field resources. Improved equipment operation will help optimize system performance.

APPENDIX C

**OPENING BRIEF OF PACIFIC GAS AND ELECTRIC
COMPANY (U 39-E) ON PHASE 2 ISSUES**

APPENDIX C

RESPONSE TO REMAINING EVERGREEN EVALUATION RECOMMENDATIONS

Recommendation 1b: *The CPUC consider requiring a review of the non-competitive bidding cases before they are contracted.* In its assessment in D.18-10-052, the Commission decided not to adopt this recommendation, as they determined it would not be feasible for the Commission to review each individual case of non-competitive bids, and that doing so would cause administrative delays¹⁸. PG&E strongly agrees with the Commission. The Commission directed the Utilities to address related Recommendations 1a and 1b in their RAP, to provide additional information and transparency in their reporting on the use of competitive and non-competitive bidding, and the Utilities have each implemented these recommendations.

Recommendation 2a: *The CPUC establish priorities among its current policy goals and funding criteria to better guide the administrators in their investment planning.* PG&E has addressed this recommendation above, in response to Issue 3. In summary, PG&E supports this recommendation and welcomes additional engagement and guidance from the Commission in setting priorities.

Recommendation 2c: *The administrators' Investment Plans are closely reviewed to ensure they not only meet program requirements, but that they are also effective in advancing the energy policy priorities that the CPUC identifies.* In response to Issue 3 above, PG&E recommends that the Commission consider employing a top-down framework of overarching goals, strategies for meeting those goals, and the associated obstacles and challenges as a means to identify and communicate priorities for EPIC. PG&E recommends that the Commission use such a framework as an additional lens through which to evaluate the Administrators' investment plans.

¹⁸ D.18-10-052, p. 23

Recommendation 3c: *The CPUC review the IOUs' project research plans (which we have recommended that they make public as they are developed) to ensure that there is no unnecessary duplication in their EPIC 3 projects.* This recommendation relates closely to Recommendation 3b that “The utilities should share project research plans and budgets with the Commission and the public, at least one month prior to launch.” The Utilities were directed by the Commission to address Recommendation 3b in their RAP and developed a common template for sharing project plans prior to launch. PG&E also committed in the RAP to conducting public workshops before launching each subsequent wave of EPIC projects and will present plans for candidate projects in these workshops using the common template developed for Recommendation 3b. The Commission will be involved in these new pre-launch workshops, and along with other stakeholders, will have the opportunity to scrutinize for unnecessary duplication and provide any other input to refine project scoping prior to launch.

Recommendation 3e: *The CPUC review IP rules or guidance developed for the Department of Energy's Small Business Innovation Research (SBIR) Program to explore possible opportunities for easing IP requirements. Regardless of the outcome of any such efforts, the CPUC should ensure that IP requirements are communicated effectively.* In D.18-10-052¹⁹, the Commission declined to adopt Evergreen’s recommendation, because “we are affirming the CEC’s intended approach to IP, and because we expect to address IP matters again in the near future, if the Commission opens a new rulemaking. There, the suggestions of Evergreen and the various approaches suggested by the CEC can be considered for adoption.” As previously recommended in PG&E’s IP comments throughout the EPIC proceedings, the Commission should retain and expand the EPIC IP requirements to ensure that IP developed with IOU customer funding is licensed and used for the direct benefit of the ratepayers whose rates fund EPIC and without the requirement that the IOUs and their ratepayers pay twice for access and use of EPIC IP.

¹⁹ D.18-10-052, p. 23

Recommendation 3f: *The administrators should use the Advice Letter process only for requesting substantive changes to projects or adding new projects that are not covered by one of the existing general descriptions in their Investment Plans.*

As PG&E demonstrates above in response to Issue 4a, the level of detail required of the Utilities during investment planning, often years in advance of project initiation, and the limited avenue for modifying investment plans (via Tier 3 Advice Letter) once approved, collectively result in almost no flexibility to respond to an evolving technology landscape or evolving needs and priorities during an investment cycle. PG&E recommends in response to Issue 4a that the Utilities' investment plans be comprised of sets of initiatives, as opposed to rigid sets of specific projects, to greatly increase flexibility during investment plan execution. If the Commission adopts this recommendation and allows the Utilities to file investment plans at the initiative level as the CEC does today, this should provide adequate improvements in flexibility without needing to also modify the Tier 3 Advice Letter process. If PG&E were to identify an entirely new initiative during investment plan execution that was not included in the investment plan, then adding the new initiative would be a significant enough change to justify the rigor and time-intensiveness of a Tier 3 Advice Letter process.

Recommendation 3g: *The CEC explore how and whether it could add more flexibility to its grant request forms and/or research planning process to be able to respond to market and technology changes that occur between the time the project is proposed and the project is launched.* In D.18-10-052, the Commission deferred to the CEC's own experience regarding how to best pursue whatever flexibility is needed in its own rules to allow it to adjust a project scope of work.²⁰ PG&E agrees with the Commission's assessment and has no further comments on this recommendation.

Recommendation 4a: *The administrators share information while projects are in progress with the CPUC and the public on a more frequent basis, such as quarterly.* In D.18-10-

²⁰ D.18-10-052, p. 66.

052, the Commission endorsed the substance of Evergreen’s findings and suggested response, but also agreed with parties’ comments that quarterly reporting would be too frequent and offered that the PICG will address this matter and develop a workable solution.²¹ The Administrators and Commission are currently working with the PICG coordinator to establish a unified EPIC database, and define the common set of underlying data elements and associated frequency of updates.

Recommendation 4b: *The administrators collaborate and jointly convene a quarterly workshop to share results about project status and lessons to-date on a topical basis, with engagement from stakeholders on topics that are of interest.* In D.18-10-052, the Commission acknowledged the burden of quarterly workshops, and pointed to the PICG and its associated public information sharing meetings as an avenue that addresses this recommendation²². PG&E agrees that the additional public coordination through the PICG, paired with existing EPIC stakeholder engagements, are sufficient in addressing the intent of this recommendation. As previously mentioned, PG&E will also conduct public workshops moving forward in advance of the launch of each new wave of EPIC projects, to supplement the existing annual Symposium and Fall Workshop.

Recommendation 4d: *The administrators develop a process to jointly report on EPIC's short-, mid- and long-term project benefits across the portfolio on a routine basis (e.g., annually) to the CPUC, relevant stakeholders and the general public.* In D.18-10-052, the Commission acknowledged that jointly sharing short-, mid-, and long-term benefits would be a new activity for all the administrators and offered that the PICG will provide a forum for the administrators to develop a joint process for doing so. The Commission also acknowledged that it is not necessarily valuable for the possible benefits of every single project to be disseminated while the project is ongoing.²³ The Commission had adopted related Recommendation 4c and directed the

²¹ D.18-10-052, p .70.

²² D.18-10-052, p. 70.

²³ D.18-10-052, p. 73.

Utilities to define processes for improving their benefits tracking in their RAP. Through the RAP the Utilities have defined benefits quantification processes and committed to both quantifying any benefits realized through the course of project demonstration as well as providing forward-looking estimates of potential benefits if solutions are deployed in production and at scale. PG&E looks forward to coordinating with stakeholders through the PICG on how and when benefits estimates might be further classified and shared as suggested in Recommendation 4d.

Recommendation 4e: *The CEC's project benefits quantification processes be reviewed again once more projects are completed.* In its comments on this recommendation, the CEC suggests that additional formal review of its project quantification process is an appropriate topic for the post 2020 program discussion²⁴. PG&E supports both this recommendation and the CEC's position, as any learnings from this review would only help the Utilities improve their own benefits quantification processes. The Commission should consider leveraging the PICG as a forum for socializing this effort.

Recommendation 4g: *SDG&E's project closeout reports be reviewed once projects are completed to ensure results are being widely disseminated.* This recommendation was made when SDG&E had yet to complete any projects and release their associated closeout reports. As SDG&E has now completed and publicly shared numerous project closeout reports, this recommendation may no longer be relevant. PG&E defers to the Commission as to what additional action, if any, is needed.

Recommendation 4h: *The administrators jointly develop a single EPIC website and listserv to post and distribute project information.* This recommendation is being directly addressed as part of the PICG. The PICG coordinator, Commission and Administrators are currently working to define the information to be contained in a joint EPIC database and associated website as the public interface to the database.

²⁴ D.18-10-052, p .74.

Recommendation 5a: *The CPUC consider using our characterization of the EPIC portfolio in terms of the types of technologies and studies and their commercialization status as baselines against which to compare future iterations of EPIC.* Recommendation 2b, which the Commission directed the Utilities to address in their RAP, called for “The administrators collaborate in categorizing and summarizing projects (such as by technology type and/or policy area) and review projects by topic areas to ensure that the portfolio of projects effectively supports key policy goals.” As part of the Utilities’ response to this recommendation, they coordinated with the CEC and the four Administrators developed their own common set of technology types to categorize their collective EPIC III investments. As such, Recommendation 5a no longer appears to be relevant.

Recommendation 5b: *The CPUC regularly evaluate EPIC to confirm that the CEC is ensuring the Market Facilitation projects are effectively connected to and serving the needs of the Applied R&D and TD&D projects.* PG&E recommends that this activity be more of a collaboration among the IOUs, CEC and Commission, as opposed to an evaluation conducted by the Commission. It would be beneficial to review the IOUs’ preliminary sets of EPIC III projects as they near completion to determine which technologies might benefit from subsequent support from the CEC’s Market Facilitation program through the transition from a limited-scale demonstration to market deployment. The PICG would be an appropriate forum for such collaboration.

Recommendation 6a: *The CPUC and/or the administrators fund and convene an independent body to coordinate, facilitate and lend technical expertise.* The Commission responded to this recommendation by establishing the PICG, and as such, the recommendation has been fully addressed.

Recommendation 7a: *Using the theory-driven framework developed for this evaluation, monitor and report key performance metrics on an on-going basis and conduct a comprehensive evaluation every three to four years. All of these evaluation activities should be conducted by an independent evaluator in close collaboration with the four administrators to avoid any*

duplication of efforts and to ensure that the results will be useful to all stakeholders (e.g., the CPUC, state legislators, and the four administrators and other stakeholders). PG&E addresses key performance metrics and ongoing program evaluation in response to Issue 7 below.

Recommendation 7c: *Modify (and continually update as needed) the characterization of the Program to more accurately reflect its complexity.* PG&E is supportive of improving the characterization and better reflecting the complexity of the EPIC program. The effort currently underway through the PICG to create a joint database of EPIC project information with standardized sets data elements and common categorizations across the four Administrators will be a valuable step towards this end. PG&E has also recommended modification to the characterization of overarching EPIC investment areas in response to Issue 4c above.

Recommendation 7d: *Modify (and continually update as needed) the EPIC program theory and logic models to better reflect the more complex character of the Program.* The logic models developed by Evergreen and included in their Evaluation Report²⁵ do not appear to have served a valuable purpose. PG&E is reluctant to dedicate resources to modifying and continually updating such logic models without a clear indication of the purpose of such models or their intended users.

Recommendation 7e: *Revisit the key performance metrics that should be tracked and the frequency with which they should be tracked and reported.* PG&E addresses key performance metrics in response to Issue 7a in the Opening Brief, above.

²⁵ EPIC Evaluation Final Report, Appendix B.